

Specifications

Police Department Midtown District

Madison, Wisconsin

Exhibit B

Contract No: 7726

Munis Number: 10390

Engberg Anderson Project No. 152413.01

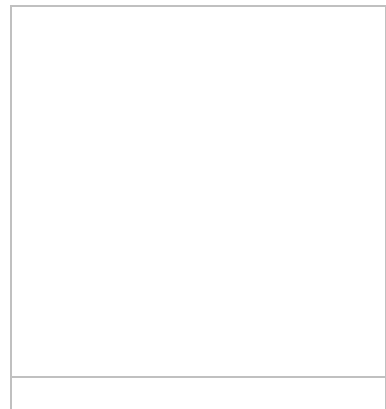
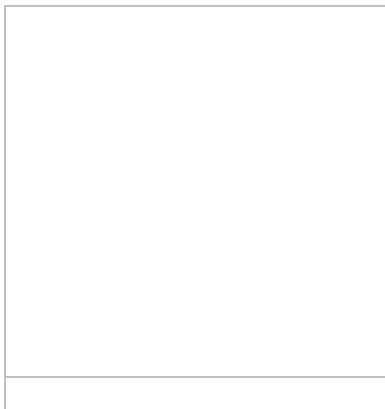
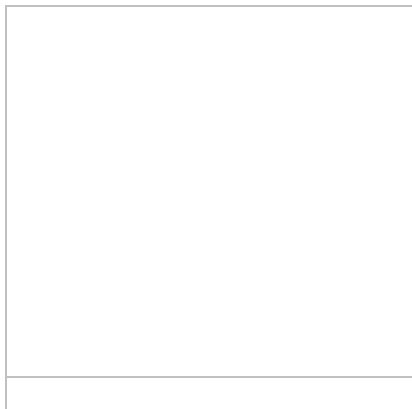
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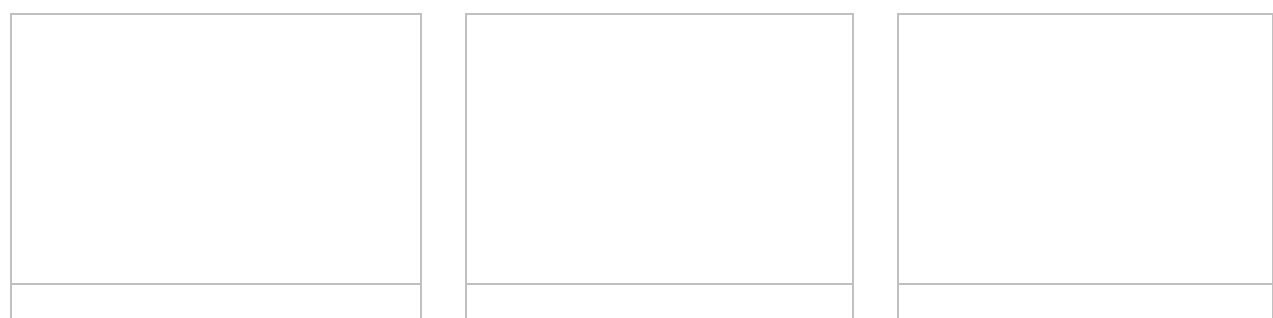
POLICE DEPARTMENT MIDTOWN DISTRICT

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10
11 **PART 1 – GENERAL**

12
13 **1.1. SUMMARY**

- 14 A. Each project has varying requirements for permits, inspections, and fees based on the scope, size, and location of
15 the project.
16 B. The City of Madison (Owner) is subject to all permits, inspections and associated fees for construction,
17 demolition, utility connection, storm water management, and other similar requirements that may be required
18 to complete the scope of work associated with these contract documents.
19 C. The General Contractor (GC) shall be responsible for obtaining all permits, inspections and paying for all
20 associated fees unless specifically identified within this specification.
21

22 **1.2. REFERENCES**

- 23 A. The following references are not intended to be all inclusive. It shall be the GC’s responsibility to determine all
24 requirements based on the scope of work in the contract documents.
25 B. City of Madison Ordinances: Review all ordinances that may require a permit or fee that may be connected with
26 a required permit. Contact the following City Agencies to determine the exact requirements during bidding.
27 1. Building Inspection
28 2. Zoning
29 3. Engineering
30 4. Water Utility
31 5. Traffic Engineering
32 6. Others as may be specified by the contract documents.
33 B. State Statutes
34 C. Other Regulatory Regulations
35 D. Other Agencies or companies that may have related requirements
36 1. Madison Metropolitan Sewerage District
37 2. Local gas and electric utility companies
38 3. Other utility companies
39

40 **1.3. GENERAL CONTRACTORS REQUIREMENTS**

- 41 A. The GC shall be responsible for all of the following:
42 1. Execute application for all required permits as may be required by the scope of work described within the
43 contract documents.
44 2. Paying all fees associated with the application of any required permits.
45 3. Scheduling all required inspections that may be conditions of any required permits.
46 B. The GC shall provide high quality scanned images of all required permits and inspections and upload them to the
47 Contract Documents-Regulatory Documents Library on the Project Management Web Site.
48

49 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

50
51 **PART 3 – EXECUTION – THIS SECTION NOT USED**

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53
54
55 **END OF SECTION**
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1 DOCUMENT 003132 - GEOTECHNICAL DATA

2 1.1 GEOTECHNICAL DATA

3 A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for
4 Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than
5 serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but
6 are not a warranty of existing conditions. This Document and its attachments are not part of the Contract
7 Documents.

8 B. A geotechnical exploration report for Project, prepared by CGC, Inc., dated April 28, 2016, is bound in its entirety
9 within the Project Manual and is appended to this Document.

10 C. Related Requirements:

- 11 1. Section A "Advertisement for Bids and Instructions to Bidders" for the Bidder's responsibilities for
12 examination of Project site and existing conditions.
13 2. Document A&A Environmental, Inc. Inspection Report dated February 8, 2014 for hazardous materials
14 reports are made available to bidders.

15 END OF DOCUMENT 003132

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Construction • Geotechnical
Consulting Engineering/Testing

April 28, 2016
C16050-1

Mr. James Whitney, AIA
Department of Public Works
City of Madison
Madison, WI 53717
(email: jwhitney@cityofmadison.com)

Re: Geotechnical Exploration Report
Midtown Police Station
Mineral Point Road & Westmoreland Blvd.
Madison, Wisconsin

Dear Mr. Whitney:

Construction • Geotechnical Consultants, Inc. (CGC) has completed the geotechnical exploration program for the project referenced above. The purpose of this exploration program was to evaluate the subsurface conditions within the proposed construction area and to provide geotechnical recommendations regarding site preparation, foundation, floor slab, below-grade wall and pavement design/construction, as well as stormwater infiltration potential. An electronic copy of this report is provided for your use, and a paper copy can be sent to you upon request.

PROJECT DESCRIPTION/SITE CONDITIONS

The site is located on the northeast corner of Mineral Point Road and Westmoreland Boulevard in Madison. We understand that the project will include a one-story building with one level of underground parking. We were informed that the first floor level will be established at Elevation (EL) 1016 ft (based on USGS datum). Underground parking slab grade is to be about 12 ft (EL 1004) below first floor level. Cutting of up to 11 ft will be required to establish lower level grades. Structural loads for the building are not available but are expected to be no more than 200 kips for columns and less than 10 kips/ft for wall loads. Entrance drives are planned from Mineral Point Road and Westmoreland Boulevard, with parking to the east of the building. Stormwater features are planned to the north of the building and in the parking lot area.

The existing site contains an existing church and is surrounded by other residential properties. Site topography is generally flat with a gentle slope down from the south to north. Based on a provided topographic drawing, site grades range from about EL 1011 to 1015 ft.

SUBSURFACE CONDITIONS

Subsurface conditions on site were explored by drilling six Standard Penetration Test (SPT) soil borings to planned depths of 20 to 30 ft below existing site grades. Borings are labeled 1 to 4 for the building, 5 for parking lot and 6 is for stormwater. The boring locations were selected by the project team, and the locations were staked in the field by CGC personnel. Badger State Drilling (under subcontract to CGC) drilled the borings on April 5 and 6 using a truck-mounted CME-55 drill rig equipped with hollow-stem

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augers and an automatic SPT hammer. The ground surface elevations were interpolated from the provided topographic drawing, and the elevation should be considered approximate. The boring locations are shown in plan on the Soil Boring Location Exhibit attached in Appendix B.

The subsurface profiles at the boring locations were fairly similar and a generalized profile can be described by the following strata in descending order:

- 3 to 6 in. of *topsoil* or about 11 in. of *asphalt/base course*; over
- 0 to 7 ft of *fill* containing stiff to very stiff clay or silty sand and gravel; then
- 2.5 to 6 ft of very soft to stiff *lean clay*; followed by
- Loose to medium dense *sand strata* with varying silt and gravel contents, as well as scattered cobbles/boulders to the maximum depth explored.

As an exception to the generalized profile, Boring 3 encountered very loose to loose *sand* with some silt and clay below the clay layer.

Groundwater was not encountered in the borings during or shortly after drilling. Groundwater levels can be expected to fluctuate with seasonal variations in precipitation, infiltration, evapotranspiration and other factors. A more detailed description of the site soil and groundwater conditions is presented on the Soil Boring Logs attached in Appendix B.

DISCUSSION AND RECOMMENDATIONS

Subject to the limitations discussed below and based on the subsurface exploration, it is our opinion that the site is suitable for the proposed construction. However, undercutting/removal of softer clays in the pavement area should be expected, and the project budget should include a contingency for this procedure. Our recommendations for site preparation, foundation, floor slab, below-grade wall and pavement design/construction, as well as stormwater infiltration parameters are presented in the following subsections. Additional information regarding the conclusions and recommendations presented in this report is discussed in Appendix C.

1. Site Preparation

We recommend that the existing building be demolished/removed within the building area including foundation walls, foundation, slab, cisterns, etc. Demolition debris should be hauled off site to a licensed landfill or potentially be recycled. The underlying soils should be checked to document that the soils are suitable for building support prior to backfilling. If loose or soft/yielding areas are encountered, these areas should be undercut and replaced with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557). Alternatively, 3-in. dense graded base (DGB) can be used to restore grades in undercut areas.

Once the existing buildings are removed, we recommend that the surficial topsoil fill be stripped beyond the proposed construction areas, including areas required for cuts and fills beyond the building footprint or pavement limits. A typical stripping depth should extend at least 1 ft beyond the building/pavement



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edge for each foot of fill/cut required in that area. The topsoil is expected to be up to 6 in. thick based on the borings, but thicker deposits may be encountered due to previous grading activities. Removal of existing trees, including roots, can occur at this time. The topsoil can be stockpiled on-site and re-used as fill in landscape areas. Excavation to the lower level parking grade can then commence.

After topsoil removal, the exposed subgrades are expected to consist primarily of native clay or sand/clay fill soils. The exposed soils in areas at-grade or where filling is required to establish grades should be proof-rolled with a loaded tri-axle dump truck to check for soft/yielding areas. If unstable areas are detected, an initial attempt could be made to aerate and densify the subgrade by recompaction where natural moisture contents are at appropriate levels (i.e., near the optimum moisture content). Note that drying and recompaction may require several cycles of disking during appropriate (i.e., warm and dry) weather conditions in order to develop a firm subgrade. If this procedure is ineffective or not practical because of the project schedule, the disturbed soils should be undercut and replaced with granular backfill compacted to at least 95% compaction based on modified Proctor methods (ASTM D1557) and/or stabilizing materials such as imported 3-in. dense graded base (DGB). *Some undercutting/replacement of soft/marginal clays and unsuitable fill should be expected, and we recommend that the project budget include a contingency for these operations.* A firm, non-yielding subgrade should be established prior to proceeding with fill placement. Geotextile fabric or geogrid could also be used in pavement areas to provide additional stability and potential reduce undercut depths.

Where fill placement is required to establish grades, we recommend using granular soils (i.e., sands/gravels) as structural fill within the building areas because sand/gravel soils are relatively easy to place and compact in most weather conditions. Silt or clay soils are not recommended as structural fill within the building footprints and upper 3 ft in pavement areas because moisture conditioning may be required to achieve desired compaction levels, which could delay construction progress. Clay/silt soils may be used as fill in landscaped areas or possibly in pavement areas provided the soils are dried back to facilitate compaction. We recommend that fill/backfill be compacted to at least 95% compaction (ASTM D1557) in accordance with our Recommended Compacted Fill Specifications presented in Appendix D. Periodic field density tests should be taken by CGC staff within the fill/backfill to document the adequacy of the compactive effort.

2. Foundation Recommendations

In our opinion, the proposed structure can be supported on reinforced concrete spread footing foundations bearing on the native sand soils. However, based on the presence of very loose sand with some silt and clay in Boring 3, some undercutting may be required below footing grade. With the building assumed to have its finish basement floor elevation near EL 1004 ft, footings are generally expected to bear near EL 1002 to 1003 ft, with the elevator pad (if required) expected to bear near 996 ft. The following parameters should be used for foundation design:

- Maximum net allowable soil bearing pressure: 3,500 psf
- Minimum foundation widths:
 - Continuous wall footings: 18 in.
 - Column pad footings: 30 in.



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If footings are to be constructed above lower level grades around the exterior of the building for patios/decks, they should be designed using an allowable soil bearing pressure of 2,000 psf on compacted/tested granular backfill. Perimeter footings should be founded at least 4 ft below exterior site grades for frost protection. Footings within interior heated areas do not need to be lowered for frost protection.

Undercutting below footing grade will be required if loose sands or softer clay soils are observed at or slightly below footing grade. For an allowable bearing pressure of 3,500 psf, undercutting will be required where native clays with pocket penetrometer readings (an estimate of the unconfined compressive strength of cohesive soil) of less than 1.75 tsf are encountered at or slightly below footing grade. Where undercutting is required (including possibly for shallower exterior footings), the base of the undercut excavation should be widened beyond the footing edges at least 0.5 ft in each direction for each foot of undercut depth for stress distribution purposes. Granular backfill compacted to at least 95% (ASTM D1557) should be used to re-establish footing grade. As an alternative, 3-in. DGB that is placed in 12-in. loose lifts and thoroughly compacted until deflection ceases can be used to re-establish footing grade. CGC should be present during footing excavations to check whether subgrades are satisfactory for the design bearing pressure and to advise on corrective measures, where necessary.

We recommend using a smooth-edged backhoe bucket for footing excavations. Further, sand footing subgrade soils should be rigorously recompacted with a large vibratory plate compactor or hoe-pak (backhoe mounted compactor) to densify soils loosened/disturbed during excavation. Provided the foundation design/construction recommendations discussed above are followed, we estimate that total and differential settlements should not exceed 1.0 and 0.5 in., respectively.

3. Floor Slabs

In our opinion, the floor slab for the proposed structure can be supported on the native sands and may be designed using a subgrade modulus of 100 pci. Prior to slab construction, the subgrades should be recompacted to densify soils that may become disturbed or loosened during construction activities. The design subgrade modulus is based on a recompacted subgrade such that non-yielding conditions are developed.

To serve as a capillary break, the final 4 to 6-in. of soil placed below the slabs should consist of well-graded sand or gravel with no more than 5 percent by weight passing a No. 200 U.S. standard sieve. Importing sand/gravel for this purpose will be required. Note that some structural engineers require a 4 to 6-in. layer of dense graded base (i.e., base course) directly below the floor slab (in lieu of the drainage layer) to increase the subgrade modulus. If 6 in. or more of dense graded base is included immediately below the floor slab, the subgrade modulus can be increased to 150 pci. To further minimize the potential for moisture migration, a plastic vapor barrier should also be utilized. Fill and drainage course material placed below the slabs should be placed as described in the Site Preparation section of this report. The slabs should be structurally separate from the foundation and have construction joints and reinforcement for crack control.

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4. Below-Grade Walls

We anticipate that basement walls for the building will be laterally restrained by the floor slab and ground level framing. Therefore, *at-rest* lateral earth pressures should be used during design. To minimize the development of such pressures, granular backfill should be placed within 4 to 6 ft of the walls. Otherwise, imported free-draining backfill or siltier on-site sand with 3-D drainage board against the foundation walls can be used, as described in Appendix E. We recommend that a perimeter drainage system be installed to intercept potential surface water infiltration and that the granular backfill placed behind the walls be continuously connected to this system. The perimeter drainage system should be sloped to drain to a sump pit. To impede the inflow of surface moisture, the final 2 ft of backfill placed along the basement walls should consist of a clayey fill cap or other semi-impermeable material such as asphaltic or concrete pavement. The clay cap or pavement should be graded in a manner which promotes positive drainage away from the walls. Recommended perimeter drain details are attached to this report in Appendix E.

Before placing the wall backfill, the exterior walls should be damp-proofed with a spray-applied or mopped-on rubber or bituminous sealer. Compaction of the backfill within 3 to 5 ft of the walls should be performed with lightweight compaction equipment. The granular backfill should be compacted to a minimum of 90% modified Proctor (ASTM D1557) following Appendix D guidelines.

Walls constructed in accordance with the above recommendations may be designed for an equivalent *at-rest* fluid pressure of 55 psf per foot of depth. An equivalent fluid pressure of 200 psf per foot of depth can be used for calculating *passive* resistance, which includes a factor of safety of 2.0 to reduce lateral deflection. The basement wall design should also take into account surcharge effects which could be applied during or after construction. Exterior retaining walls (if any) which are free to rotate about the toe will be subjected to active lateral earth pressures and may be designed for an equivalent *active* fluid pressure of 35 psf per foot of depth. Exterior retaining walls should include weep holes near the base of the wall on 10 foot centers. A geotextile fabric should be placed over the weep holes to prevent soil loss.

5. Site Class for Seismic Design

In our opinion, the average soil/rock properties in the upper 100 ft of the site (based on SPT blow counts (N-values) greater than 15 on average) can be characterized as a stiff soil profile. This characterization would place the site in Site Class D for seismic design according to the International Building Code (see Table 1613.5.2).

6. Pavement Design

We anticipate that the subgrade soils within the parking and drive areas will likely consist of native clay or fill sand/clay possible newly-placed granular fill. Pavement subgrades should be proof-rolled/recompacted, as described in the Site Preparation section of this report, and stabilized as needed with 3-in. DGB or replaced with compacted granular fill. *Since the pavement subgrade is expected to primarily be cohesive soils, we anticipate that some undercutting and stabilization may be required during subgrade preparation. We recommend that the budget include a contingency for these operations.*

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 City of Madison
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We assume that the automobile parking area pavement east of the building will experience fairly light traffic loads consisting primarily of cars and light trucks (less than two design daily equivalent 18-kip single axle loads – ESALs). The entrance drive may experience larger truck volumes (up to 5 ESALs). The clay soils will control the pavement thickness design. Accordingly, the pavement sections tabulated below were selected assuming a CBR of approximately 3 for a firm or stabilized clay subgrade and a design life of 20 years.

Table 1 - Recommended Pavement Sections

Material	Car Parking/Drives (1 to 5 ESALs), in.	Drive Lanes (up to 5 ESALs), in.	WDOT Specification¹
Bituminous Upper Layer	1.5	1.75	Section 460, Table 460-1, 9.5 mm
Bituminous Lower Layer	1.75	2.25	Section 460, Table 460-1, 12.5 mm
Dense Graded Base	8.0	10.0	Sections 301 and 305, 31.5mm
TOTAL THICKNESS	11.25	14.0	

Notes:

1. Wisconsin DOT *Standard Specifications for Highway and Structure Construction*, latest edition, including supplemental specifications.
2. Compaction requirements:
 - Bituminous concrete: Refer to Section 460.3
 - Base course: Refer to Section 301.3.4.2, Standard Compaction
3. Mixture Type E-0.3 bituminous pavement is recommended; refer to Section 460, Table 460-2 of the *Standard Specifications*.

Note that if traffic volumes differ from those assumed, CGC should be allowed to review the recommended pavement sections and adjust them accordingly. The pavement design assumes a stable/non-yielding subgrade and a regular program of preventative maintenance. Alternative pavement designs may prove applicable and should be reviewed by CGC. If there is a delay between subgrade preparation and placing the base course, the subgrade should be recompact.

Concrete pavement areas with concentrated wheel loads (i.e., dumpster pads, loading dock, truck parking, entrance/exit areas, etc.) should be a minimum of 6-in. thick and should also contain reinforcement. The concrete pavement should be underlain by a minimum of 6 in. of dense graded base over a firm/non-yielding subgrade. A subgrade modulus of 100 pci should be used for concrete pavement design on proof-rolled/recompact clay subgrades.

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7. **Infiltration Potential**

We understand that a stormwater management area (infiltration and/or detention systems) may be located in the northwest portion of the site near Boring 6. The soil conditions in Boring 6 consisted of lower permeability silty clay loam and sandy loam (fill) and natural silty clay loam to about 12 ft below grade, which was underlain by slightly more permeable sandy loam. Unless the stormwater system base extends to the sandy loam, the soil conditions in Boring 6 do not appear suitable for infiltrating significant quantities of stormwater. Based on the thick low permeability silty clay loam soils, this site may qualify as “exempt” according to NR 151. The following parameters should be considered for design of infiltration features:

Infiltration Potential: The following infiltration parameters were estimated using Table 2 of the WDNR Conservation Practice Standard 1002, *Site Evaluation for Storm Water Infiltration*. The estimated infiltration rates are as follows:

- Silty clay loam (SiCL) 0.04 in./hr
- Gravelly sandy loam (GRSL) 0.5 in./hr

Note that the infiltration rates should be considered very approximate since they are merely based on soil texture and do not account for in-place soil density and other factors, which will affect the infiltration rate. Double-ring infiltrometer testing can be conducted to more accurately determine the in-place infiltration potential. We recommend that the soils at and at least 5 ft below the bottom of infiltration basins be checked by geotechnical engineer or certified soil tester to document that the soils are adequate for the design infiltration rate or recommend remedial measures, if necessary. The Wisconsin Department of Safety and Professional Services Soil Evaluation – Storm form for Boring 6 is contained in Appendix F.

Groundwater: Groundwater was not encountered in Boring 6 during or shortly after drilling. Groundwater levels should be expected to fluctuate, as previously discussed.

Bedrock: Bedrock was not encountered in the borings drilled on this site to the maximum depth explored. The depth of bedrock should be expected to vary across the site.

During construction appropriate erosion control should be provided to prevent eroded soil from contaminating the stormwater management areas. Where appropriate, the stormwater design should include pretreatment to remove fine-grained soils (silt/clay) and clogging materials (oils and greases) from stormwater prior to entering the infiltration areas. Additionally, a regular maintenance plan should be developed to remove fine-grained and clogging materials that may accumulate in the bottom of the stormwater management area over time.



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Failure to adequately control fine-grained soils and clogging materials from entering the infiltration area or failure to regularly remove fine-grained soils and clogging materials that accumulate at the base of the stormwater infiltration system will likely cause the stormwater management system to fail. Refer to WDNR Conservation Practice Standard 1002 and NR 151 for additional information.

CONSTRUCTION CONSIDERATIONS

Due to variations in weather, construction methods and other factors, specific construction problems are difficult to predict. Soil related difficulties which could be encountered on the site are discussed below:

- Due to the potentially sensitive nature of the on-site soils, we recommend that final site grading activities be completed during dry weather, if possible. Construction traffic should be avoided on prepared subgrades to minimize potential disturbance.
- Contingencies in the project budget for subgrade stabilization with coarse stone in parking and floor slab areas should be increased if the project schedule requires that work proceed during adverse weather conditions.
- Earthwork construction during the early spring or late fall could be complicated as a result of wet weather and freezing temperatures. During cold weather, exposed subgrades should be protected from freezing before and after footing construction. Fill should never be placed while frozen or on frozen ground.
- Excavations extending greater than 4 ft in depth below the existing ground surface should be sloped or braced in accordance with current OSHA standards.
- Based on observations made during the field exploration and anticipated floor elevations, groundwater infiltration into excavations is not expected to be a problem. Water accumulating at the base of excavations as a result of precipitation or seepage should be controlled and quickly removed using pumps operating from filtered sump pits. If floor grades are lowered, more extensive dewatering (well points or wells) may be required.

RECOMMENDED CONSTRUCTION MONITORING

The quality of the foundation, floor slab and pavement subgrades will be largely determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with our recommendations, the following operations should be monitored by CGC:

- Topsoil stripping/subgrade proof-rolling within the construction areas;
- Fill/backfill placement and compaction;
- Foundation excavation/subgrade preparation; and
- Concrete placement.

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Department of Public Works
April 28, 2016
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It has been a pleasure to serve you on this project. If you have any questions or need additional consultation, please contact us.

Sincerely,

CGC, Inc.



Brian S. McIlwaine, E.I.T.
Staff Engineer



Michael N. Schultz, P.E.
Principal/Consulting Professional

Encl: Appendix A - Field Exploration
Appendix B - Soil Boring Location Exhibit
Logs of Test Borings (6)
Log of Test Boring-General Notes
Unified Soil Classification System
Appendix C - Document Qualifications
Appendix D - Recommended Compacted Fill Specifications
Appendix E - Perimeter Drain Details
Appendix F - WI Dept. of Safety and Professional Services Soil Evaluation Report (1 page)

APPENDIX A

FIELD EXPLORATION

APPENDIX A

FIELD EXPLORATION

Six Standard Penetration Test (SPT) soil borings were drilled to planned depths of 20 to 30 ft below existing site grades at locations selected by the project team. CGC personnel located the borings in the field and ground surface elevations were interpolated from the provided topographic drawing and should be considered approximate. Badger State Drilling (under subcontract to CGC) drilled the borings starting on April 5 and 6 using a truck mounted CME-55 drill rig equipped with hollow-stem augers and an automatic SPT hammer. The boring locations are shown in plan on the Soil Boring Location Map attached in Appendix B.

In each boring, soil samples were obtained at 2.5 foot intervals to a depth of 10 ft and at 5 ft intervals thereafter. The soil samples were obtained in general accordance with specifications for standard penetration testing, ASTM D 1586. The specific procedures used for drilling and sampling are described below.

1. Boring Procedures between Samples

The boring is extended downward, between samples, by a hollow-stem auger.

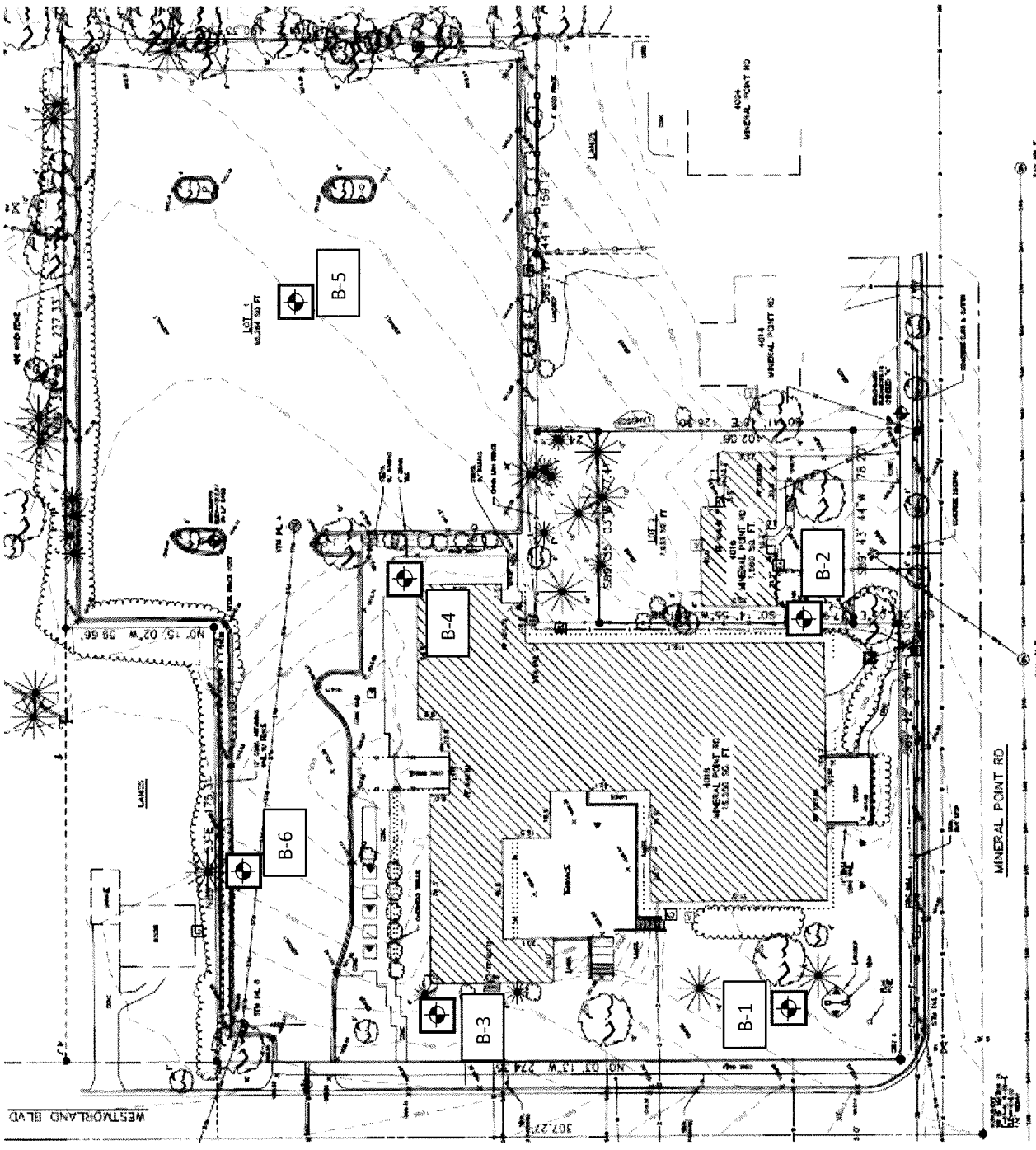
2. Standard Penetration Test and Split-Barrel Sampling of Soils
(ASTM Designation: D 1586)

This method consists of driving a 2-inch outside diameter split-barrel sampler using a 140-pound weight falling freely through a distance of 30 inches. The sampler is first seated 6 inches into the material to be sampled and then driven 12 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the log of borings and is known as the Standard Penetration Resistance.

During the field exploration, the driller visually classified the soil and prepared a field log. *Field screening of the soil samples for possible environmental contaminants was not conducted by the drillers as these services were not part of CGC's work scope.* Water level observations were made in each boring during and after drilling and are shown at the bottom of each boring log. Upon completion of drilling, the borings were backfilled with bentonite (where required) to satisfy WDNR regulations and the soil samples were delivered to our laboratory for visual classification and laboratory testing. The soils were visually classified by a geotechnical engineer using the Unified Soil Classification System. The final logs prepared by the engineer and a description of the Unified Soil Classification System are presented in Appendix B.

APPENDIX B

**SOIL BORING LOCATION EXHIBIT
LOGS OF TEST BORINGS (6)
LOG OF TEST BORING – GENERAL NOTES
UNIFIED SOIL CLASSIFICATION SYSTEM**



Scale: Reduced

Legend  Denotes Coring Location and Number

- Notes**
1. Boring were performed on April 5 and 6, 2016.
 2. Base map was provided by Cedar Corporation.
 3. Boring locations are approximate.

Job No.
C16050-1

Date:
4/2016

CGC, Inc.

BORING LOCATION EXHIBIT

**Midtown Police Station
Mineral Point and Westmoreland Blvd.
Madison, WI**



LOG OF TEST BORING

Project Midtown Police Station
 Location Madison, WI

Boring No. 1
 Surface Elevation (ft) 1014 +/-
 Job No. C16051-1
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (tsf)	W	LL	PL	LI
1	10	M	5	5	3 in. TOPSOIL (OL) Medium Stiff to Stiff, Brown Lean CLAY (CL)	(1.0)				
2	18	M	9	9	Very soft and Sandy near 6 ft Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)	(1.75)	26.3			
3	15	M	5	12		(<0.2)	23.7			
4	18	M	12	12	Hard drilling noted near 17 ft					
5	18	M	16	16						
6	18	M	20	20						
7	18	M	25	25	End of Boring at 30 ft Backfilled with Bentonite Chips					
8	18	M	26	26						

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling NW Upon Completion of Drilling _____
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start 4/5/16 End 4/5/16
 Driller BSD Chief DB Rig D-50
 Logger MC Editor ESF
 Drill Method 2.25" HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project Midtown Police Station
 Location Madison, WI

Boring No. 2
 Surface Elevation (ft) 1015 +/-
 Job No. C16051-1
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					0	4 in. of TOPSOIL				
1		12	M	4	4	FILL: Stiff, Brown Clay with Traces of Sand, Gravel and Topsoil				
2		15	M	8	8	Stiff, Brown Lean CLAY (CL)				
3		18	M	10	10	Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)				
4		18	M	13	13	Hard drilling noted near 15 ft				
5		18	M	17	17					
6		18	M	20	20					
7		18	M	20	25	End Boring at 30 ft Backfilled with Bentonite Chips				
8		18	M	24	30					
					35					

WATER LEVEL OBSERVATIONS

While Drilling NW Upon Completion of Drilling _____
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

GENERAL NOTES

Start 4/5/16 End 4/5/16
 Driller BSD Chief DB Rig D-50
 Logger MC Editor ESF
 Drill Method 2.25" HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project Midtown Police Station
 Location Madison, WI

Boring No. 3
 Surface Elevation (ft) 1011 +/-
 Job No. C16051-1
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	q _u (qa) (tsf)	W	LL	PL
1		15	M	9	6 in. of TOPSOIL FILL: Very Stiff, Brown Clay with Traces of Sand, Gravel and Topsoil	(3.0)				
2		18	M	8	Stiff, Brown Lean CLAY (CL)	(1.5)	28.8			
3		18	M/W	4	Loose to Very Loose, Brown Fine to Medium SAND, Some Silt and Clay (SM/SC)		20.6			
4		18	M	10	Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)					
5		18	M	13						
6		18	M	19						
7		18	M	13						
8		18	M	15						
					End of Boring at 30 ft					
					Backfilled with Bentonite Chips					

WATER LEVEL OBSERVATIONS

GENERAL NOTES

While Drilling **NW** Upon Completion of Drilling _____
 Time After Drilling _____
 Depth to Water _____
 Depth to Cave in _____

Start 4/5/16 End 4/5/16
 Driller BSD Chief DB Rig D-50
 Logger MC Editor ESF
 Drill Method 2.25" HSA; Autohammer

The stratification lines represent the approximate boundary between soil types and the transition may be gradual.



LOG OF TEST BORING

Project Midtown Police Station

Location Madison, WI

Boring No. 4

Surface Elevation (ft) 1012 +/-

Job No. C16051-1

Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qsf) (tsf)	W	LL	PL
1	█	10	M	8	0 - 3.5	3.5 in. TOPSOIL FILL: Stiff to Very Stiff, Brown Clay with Traces of Sand, Gravel and Topsoil (3 in. Layer of Asphalt Over Sand and Gravel at 2.5 ft)	(2.0)			
2	█	16	M	14	3.5 - 5	Soft to Stiff, Brown Lean CLAY (CL)	(1.5)	27.1		
3	█	12	M	6	5 - 6		(0.5)	24.1		
4	█	16	M	13	6 - 10	Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)				
5	█	18	M	15	10 - 15					
6	█	18	M	17	15 - 20					
7	█	18	M	25	20 - 25					
8	█	18	M	26	25 - 30					
End of Boring at 30 ft										
Backfilled with Bentonite Chips										

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <input checked="" type="checkbox"/> <u>NW</u> Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>4/5/16</u> End <u>4/5/16</u> Driller <u>BSD</u> Chief <u>MC</u> Rig <u>D-50</u> Logger <u>MC</u> Editor <u>ESF</u> Drill Method <u>2.25" HSA; Autohammer</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	



LOG OF TEST BORING

Project Midtown Police Station
 Location Madison, WI

Boring No. 5
 Surface Elevation (ft) 1012 +/-
 Job No. C16051-1
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	TYPE	Rec (in.)	Moist	N		Depth (ft)	qu (qa) (tsf)	W	LL	PL
					0	3 in. Asphalt Pavement/8 in. Base Course				
1	█	12	M	6	0	Very Soft to Medium Stiff, Brown Lean CLAY (CL)				
2	█	10	W	8	0	(0.75)	28.5			
3	█	16	M	12	5	(0.2)				
4	█	18	M	11	5					
					10	Loose to Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM)				
5	█	6	M	18	10					
					15					
6	█	18	M	23	15					
					20					
7	█	16	M	26	20					
					25					
8	█	14	M	33	25					
					30	Dense near 29 ft				
					30	End of Boring at 30 ft				
					35	Backfilled with Bentonite Chips and Asphalt Patch				

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <input checked="" type="checkbox"/> <u>NW</u> Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>4/6/16</u> End <u>4/6/16</u> Driller <u>BSD</u> Chief <u>MB</u> Rig <u>D-50</u> Logger <u>KD</u> Editor <u>ESF</u> Drill Method <u>2.25" HSA; Autohammer</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	



LOG OF TEST BORING

Project Midtown Police Station
 Location Madison, WI

Boring No. 6
 Surface Elevation (ft) 1012 +/-
 Job No. C16051-1
 Sheet 1 of 1

2921 Perry Street, Madison, WI 53713 (608) 288-4100, FAX (608) 288-7887

SAMPLE					VISUAL CLASSIFICATION and Remarks	SOIL PROPERTIES				
No.	Rec (in.)	Moist	N	Depth (ft)		qu (qa) (tsf)	W	LL	PL	LI
					X	3 in. Asphalt Pavement/8 in. Base Course				
1	6	M	14		█	FILL: Medium Dense, Brown Silty Sand and Gravel Mixed with Crushed Aggregate USDA: 10 YR 4/4 Sandy Loam with Silty Clay Loam (Fill)				
2	14	M	14		█	Some Clay noted near 5 ft				
3	3	M	55/9"		█	Large Cobble/Boulder Noted				
4	6	M	5		█	Soft to Very Soft, Brown Lean CLAY (CL) USDA: 10 YR 4/3 Silty Clay Loam				
					█	Medium Dense, Brown Fine to Medium SAND, Some Silt and Gravel, Scattered Cobbles and Boulders (SM) USDA: 7.5 YR 5/4 Gravelly Sandy Loam				
5	12	M	15		█					
6		M	20		█					
						End of Boring at 20 ft				
						Backfilled with Bentonite Chips and Asphalt Patch				

WATER LEVEL OBSERVATIONS	GENERAL NOTES
While Drilling <input checked="" type="checkbox"/> NW Upon Completion of Drilling _____ Time After Drilling _____ Depth to Water _____ Depth to Cave in _____	Start <u>4/6/16</u> End <u>4/6/16</u> Driller <u>BSD</u> Chief <u>MB</u> Rig <u>D-50</u> Logger <u>KD</u> Editor <u>ESF</u> Drill Method <u>2.25" HSA; Autohammer</u>
The stratification lines represent the approximate boundary between soil types and the transition may be gradual.	

LOG OF TEST BORING
General Notes

DESCRIPTIVE SOIL CLASSIFICATION

Grain Size Terminology

Soil Fraction	Particle Size	U.S. Standard Sieve Size
Boulders	Larger than 12"	Larger than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse.....	3/4" to 3"	3/4" to 3"
Fine.....	4.76 mm to 3/4".....	#4 to #3"
Sand: Coarse.....	2.00 mm to 4.76 mm.....	#10 to #4
Medium	0.42 to mm to 2.00 mm	#40 to #10
Fine	0.074 mm to 0.42 mm.....	#200 to #40
Silt.....	0.005 mm to 0.074 mm.....	Smaller than #200
Clay.....	Smaller than 0.005 mm.....	Smaller than #200

Plasticity characteristics differentiate between silt and clay.

General Terminology

Physical Characteristics
Color, moisture, grain shape, fineness, etc.
Major Constituents
Clay, silt, sand, gravel
Structure
Laminated, varved, fibrous, stratified, cemented, fissured, etc.
Geologic Origin
Glacial, alluvial, eolian, residual, etc.

Relative Density

Term	"N" Value
Very Loose.....	0 - 4
Loose.....	4 - 10
Medium Dense.....	10 - 30
Dense.....	30 - 50
Very Dense.....	Over 50

Relative Proportions Of Cohesionless Soils

Proportional Term	Defining Range by Percentage of Weight
Trace.....	0% - 5%
Little.....	5% - 12%
Some.....	12% - 35%
And	35% - 50%

Consistency

Term	q _u -tons/sq. ft
Very Soft.....	0.0 to 0.25
Soft.....	0.25 to 0.50
Medium.....	0.50 to 1.0
Stiff.....	1.0 to 2.0
Very Stiff.....	2.0 to 4.0
Hard.....	Over 4.0

Organic Content by Combustion Method

Soil Description	Loss on Ignition
Non Organic.....	Less than 4%
Organic Silt/Clay.....	4 - 12%
Sedimentary Peat.....	12% - 50%
Fibrous and Woody Peat...	More than 50%

Plasticity

Term	Plastic Index
None to Slight.....	0 - 4
Slight.....	5 - 7
Medium.....	8 - 22
High to Very High ..	Over 22

The penetration resistance, N, is the summation of the number of blows required to effect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test.

SYMBOLS

Drilling and Sampling

- CS – Continuous Sampling
- RC – Rock Coring: Size AW, BW, NW, 2"W
- RQD – Rock Quality Designation
- RB – Rock Bit/Roller Bit
- FT – Fish Tail
- DC – Drove Casing
- C – Casing: Size 2 1/2", NW, 4", HW
- CW – Clear Water
- DM – Drilling Mud
- HSA – Hollow Stem Auger
- FA – Flight Auger
- HA – Hand Auger
- COA – Clean-Out Auger
- SS - 2" Dia. Split-Barrel Sample
- 2ST – 2" Dia. Thin-Walled Tube Sample
- 3ST – 3" Dia. Thin-Walled Tube Sample
- PT – 3" Dia. Piston Tube Sample
- AS – Auger Sample
- WS – Wash Sample
- PTS – Peat Sample
- PS – Pitcher Sample
- NR – No Recovery
- S – Sounding
- PMT – Borehole Pressuremeter Test
- VS – Vane Shear Test
- WPT – Water Pressure Test

Laboratory Tests

- q_a – Penetrometer Reading, tons/sq ft
- q_a – Unconfined Strength, tons/sq ft
- W – Moisture Content, %
- LL – Liquid Limit, %
- PL – Plastic Limit, %
- SL – Shrinkage Limit, %
- LI – Loss on Ignition
- D – Dry Unit Weight, lbs/cu ft
- pH – Measure of Soil Alkalinity or Acidity
- FS – Free Swell, %

Water Level Measurement

- ▽ - Water Level at Time Shown
- NW – No Water Encountered
- WD – While Drilling
- BCR – Before Casing Removal
- ACR – After Casing Removal
- CW – Cave and Wet
- CM – Caved and Moist
















Note: Water level measurements shown on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

CGC, Inc.

Madison - Milwaukee

Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size)		
Clean Gravels (Less than 5% fines)		
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	 GW	Well-graded gravels, gravel-sand mixtures, little or no fines
	 GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	
	 GM	Silty gravels, gravel-sand-silt mixtures
	 GC	Clayey gravels, gravel-sand-clay mixtures
Clean Sands (Less than 5% fines)		
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	 SW	Well-graded sands, gravelly sands, little or no fines
	 SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	
	 SM	Silty sands, sand-silt mixtures
	 SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)		
SILTS AND CLAYS Liquid limit less than 50%	 ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
	 CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
	 OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	 MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
	 CH	Inorganic clays of high plasticity, fat clays
	 OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS	 PT	Peat and other highly organic soils

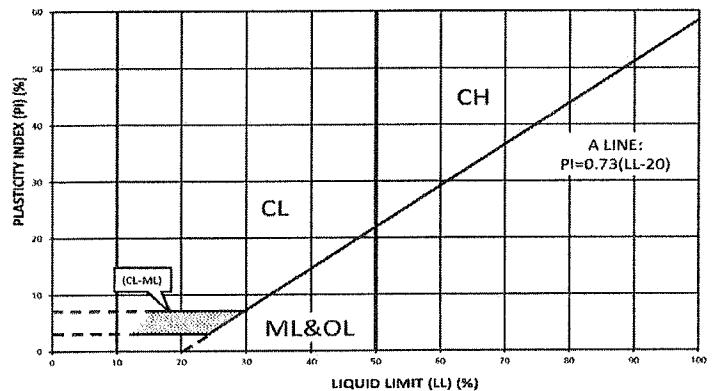
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line or P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent GW, GP, SW, SP
 More than 12 percent GM, GC, SM, SC
 5 to 12 percent Borderline cases requiring dual symbols

PLASTICITY CHART



APPENDIX C

DOCUMENT QUALIFICATIONS

APPENDIX C

DOCUMENT QUALIFICATIONS

I. GENERAL RECOMMENDATIONS/LIMITATIONS

CGC, Inc. should be provided the opportunity for a general review of the final design and specifications to confirm that earthwork and foundation requirements have been properly interpreted in the design and specifications. CGC should be retained to provide soil engineering services during excavation and subgrade preparation. This will allow us to observe that construction proceeds in compliance with the design concepts, specifications and recommendations, and also will allow design changes to be made in the event that subsurface conditions differ from those anticipated prior to the start of construction. CGC does not assume responsibility for compliance with the recommendations in this report unless we are retained to provide construction testing and observation services.

This report has been prepared in accordance with generally accepted soil and foundation engineering practices and no other warranties are expressed or implied. The opinions and recommendations submitted in this report are based on interpretation of the subsurface information revealed by the test borings indicated on the location plan. The report does not reflect potential variations in subsurface conditions between or beyond these borings. Therefore, variations in soil conditions can be expected between the boring locations and fluctuations of groundwater levels may occur with time. The nature and extent of the variations may not become evident until construction.

II. IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. *No one except you* should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one - not even you* - should apply the report for any purpose or project except the one originally contemplated.

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, *do not rely on a geotechnical engineering report* that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or project ownership.

As a general rule, , *always* inform your geotechnical engineer of project changes - even minor ones - and request an assessment of their impact. *CGC cannot accept responsibility or liability for problems that occur because our reports do not consider developments of which we were not Informed.*

SUBSURFACE CONDITIONS CAN CHANGE

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

MOST GEOTECHNICAL FINDINGS ARE PROFESSIONAL OPINION

Site exploration identifies subsurface conditions only at those points where surface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgement to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ - sometimes significantly - from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A REPORT'S RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgement and opinion, geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *CGC cannot assume responsibility or liability for the report's recommendations if we do not perform construction observation.*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having CGC participate in prebid and preconstruction conferences, and by providing construction observation.

DO NOT REDRAW THE ENGINEER'S LOGS

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

READ RESPONSIBILITY PROVISIONS CLOSELY

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce such risks, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes

labeled "limitations," many of these provisions indicate where geotechnical engineer's responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

GEOENVIRONMENTAL CONCERNS ARE NOT COVERED

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

OBTAIN PROFESSIONAL ASSISTANCE TO DEAL WITH MOLD

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

RELY ON YOUR GEOTECHNICAL ENGINEER FOR ADDITIONAL ASSISTANCE

Membership in ASFE exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with CGC, a member of ASFE, for more information.

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ASFE/The Best People on Earth
881 Colesville Road, Suite G 106
Silver Spring, MD 20910

APPENDIX D

RECOMMENDED COMPACTED FILL SPECIFICATIONS

APPENDIX D

CGC, INC.

RECOMMENDED COMPACTED FILL SPECIFICATIONS

General Fill Materials

Proposed fill shall contain no vegetation, roots, topsoil, peat, ash, wood or any other non-soil material which by decomposition might cause settlement. Also, fill shall never be placed while frozen or on frozen surfaces. Rock, stone or broken concrete greater than 6 in. in the largest dimension shall not be placed within 10 ft of the building area. Fill used greater than 10 ft beyond the building limits shall not contain rock, boulders or concrete pieces greater than a 2 sq ft area and shall not be placed within the final 2 ft of finish subgrade or in designated utility construction areas. Fill containing rock, boulders or concrete pieces should include sufficient finer material to fill voids among the larger fragments.

Special Fill Materials

In certain cases, special fill materials may be required for specific purposes, such as stabilizing subgrades, backfilling undercut excavations or filling behind retaining walls. For reference, WisDOT gradation specifications for various types of granular fill are attached in Table 1.

Placement Method

The approved fill shall be placed, spread and leveled in layers generally not exceeding 10 in. in thickness before compaction. The fill shall be placed at moisture content capable of achieving the desired compaction level. For clay soils or granular soils containing an appreciable amount of cohesive fines, moisture conditioning will likely be required.

It is the Contractor's responsibility to provide all necessary compaction equipment and other grading equipment that may be required to attain the specified compaction. Hand-guided vibratory or tamping compactors will be required whenever fill is placed adjacent to walls, footings, columns or in confined areas.

Compaction Specifications

Maximum dry density and optimum moisture content of the fill soil shall be determined in accordance with modified Proctor methods (ASTM D1557). The recommended field compaction as a percentage of the maximum dry density is shown in Table 2. Note that these compaction guidelines would generally not apply to coarse gravel/stone fill. Instead, a method specification would apply (e.g., compact in thin lifts with a vibratory compactor until no further consolidation is evident).

Testing Procedures

Representative samples of proposed fill shall be submitted to CGC, Inc. for optimum moisture-maximum density determination (ASTM D1557) prior to the start of fill placement. The sample size should be approximately 50 lb.

CGC, Inc. shall be retained to perform field density tests to determine the level of compaction being achieved in the fill. The tests shall generally be conducted on each lift at the beginning of fill placement and at a frequency mutually agreed upon by the project team for the remainder of the project.

**Table 1
Gradation of Special Fill Materials**

Material	WisDOT Section 311	WisDOT Section 312	WisDOT Section 305			WisDOT Section 209		WisDOT Section 210
	Breaker Run	Select Crushed Material	3-in. Dense Graded Base	1 1/4-in. Dense Graded Base	3/4-in. Dense Graded Base	Grade 1 Granular Backfill	Grade 2 Granular Backfill	Structure Backfill
Sieve Size	Percent Passing by Weight							
6 in.	100							
5 in.		90-100						
3 in.			90-100					100
1 1/2 in.		20-50	60-85					
1 1/4 in.				95-100				
1 in.					100			
3/4 in.			40-65	70-93	95-100			
3/8 in.				42-80	50-90			
No. 4			15-40	25-63	35-70	100 (2)	100 (2)	25-100
No. 10		0-10	10-30	16-48	15-55			
No. 40			5-20	8-28	10-35	75 (2)		
No. 100						15 (2)	30 (2)	
No. 200			2-12	2-12	5-15	8 (2)	15 (2)	15 (2)

Notes:

1. Reference: Wisconsin Department of Transportation *Standard Specifications for Highway and Structure Construction*.
2. Percentage applies to the material passing the No. 4 sieve, not the entire sample.
3. Per WisDOT specifications, both breaker run and select crushed material can include concrete that is 'substantially free of steel, building materials and other deleterious material'.

**Table 2
Compaction Guidelines**

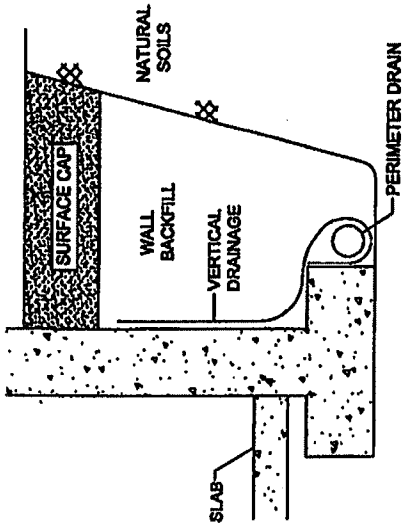
Area	Percent Compaction (1)	
	Clay/Silt	Sand/Gravel
Within 10 ft of building lines		
Footing bearing soils	93 - 95	95
Under floors, steps and walks		
- Lightly loaded floor slab	90	90
- Heavily loaded floor slab and thicker fill zones	92	95
Beyond 10 ft of building lines		
Under walks and pavements		
- Less than 2 ft below subgrade	92	95
- Greater than 2 ft below subgrade	90	90
Landscaping	85	90

Notes:

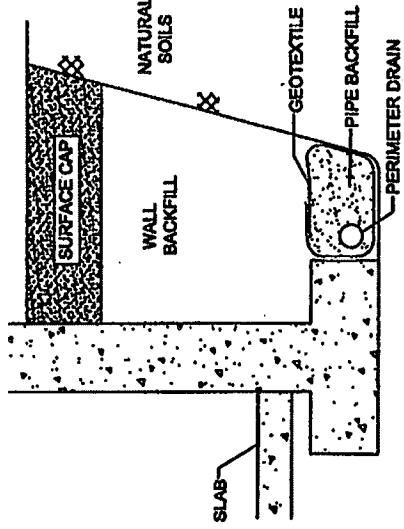
1. Based on Modified Proctor Dry Density (ASTM D 1557)

APPENDIX E

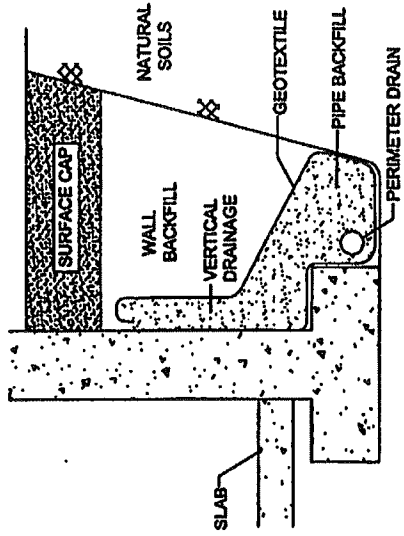
PERIMETER DRAIN DETAILS



ALTERNATE NO. 1



ALTERNATE NO. 2



ALTERNATE NO. 3

DRAINAGE SYSTEM COMPONENTS

Component	Alternate No. 1	Alternate No. 2	Alternate No. 3
Surface Cap	1 to 2 ft of clayey soils. Minimum 1 ft thick if overlain by pavement	Refer to Alternate No. 1	Refer to Alternate No. 1
Vertical Drainage	3-dimensional drainage geocomposite hydraulically connected to perimeter drain.	Relatively free-draining granular soils with P200 (% fines) ≤ 12%.	Minimum 6-in. wide zone of free-draining granular soils with P200 ≤ 5% hydraulically connected to perimeter drain. Provide geotextile as required (see note 10).
Perimeter Drain	Perforated pipe encapsulated in geocomposite.	Perforated pipe surrounded by free-draining granular pipe backfill with P200 ≤ 5%. Provide geotextile as required (See Note 10).	Refer to Alternate No. 2
Wall Backfill	Excavation spoils or imported materials (granular soils preferred).	Relatively free-draining granular soils with P200 ≤ 12%.	Refer to Alternate No. 1



Typical Perimeter Drain Detail

General Notes

1. This system's primary function is to intercept infiltrating surface water. These alternates are not appropriate for use in situations of high groundwater (i.e., cases where the water table approaches floor slab elevation).
2. Grade surface cap to slope away from structure.
3. Exterior surface of walls below grade should be damp-proofed.
4. A plastic vapor barrier should be installed below the slab.
5. Recommended types of drain pipes:

<u>Specification</u>	<u>Description</u>
ASTM D2729	Polyvinyl Chloride (PVC) Drain Pipe
ASTM F405	Corrugated Polyethylene Drain Pipe
ASTM D2852	Styrene-Rubber Plastic Drain Pipe
AASHTO M1366	Corrugated Metal Underdrain Pipe

6. Minimum slope of drain pipes should be 2 in. per 100 lin ft.

7. Place drain pipe below basement floor level and orient the perforations toward the bottom.
8. Clean-outs should be provided to service the pipe.
9. Collected field water should be discharged to a sump, storm sewer or drainage field.
10. The geotextile for Alternative Nos. 2 and 3 may be eliminated if filter requirements are satisfied between the wall and pipe backfill, as well as between backfill materials and natural soils.
11. Pipe backfill materials should satisfy filter requirements for the slot width or hole diameter of the perforated pipe.
12. Care should be taken during backfilling not to damage the integrity of the system. For compaction requirements, refer to geotechnical report.
13. Pipe, geotextile, and geocomposite should be installed according to manufacturer specifications.



APPENDIX F

**WISCONSIN DEPARTMENT OF SAFETY & PROFESSIONAL SERVICES
SOIL EVALUATION FORM (1 page)**

SOIL EVALUATION - STORM

in accordance with Comm 82.365 & 85, Wis. Adm. Code

Attach complete site plan on paper not less than 8 1/2 x 11 inches in size. Plan must include, but not limited to: vertical and horizontal reference point (BM), direction and percent slope, scale or dimensions, north arrow, and BM referenced to nearest road.

Please print all information.

Personal information you provide may be used for secondary purposes (Privacy Law, s.15.04 (1) (m)).

County	Dane
Parcel I.D.	070921317173
Review by	Date

Property Owner City of Madison Police Mid Town Station	Property Location Govt. Lot 1/4 1/4 S 21 T 07 N R 09 E
Property Owner's Mailing Address 211 S. Carroll Street	Lot # 1 and 2 Block # Subd. Name or CSM# CSM 11711
City Madison State WI Zip Code 53703 Phone Number	<input checked="" type="checkbox"/> City <input type="checkbox"/> Village <input type="checkbox"/> Town Nearest Road Madison 4018 Mineral Point Road

Drainage area _____ sq. ft. <input type="checkbox"/> acres Optional: Test Site Suitable for (check all that apply) <input type="checkbox"/> Irrigation <input type="checkbox"/> Bioretention trench <input type="checkbox"/> Trench(es) <input type="checkbox"/> Rain Garden <input type="checkbox"/> Grassed Swale <input type="checkbox"/> Reuse <input type="checkbox"/> Infiltration trench <input type="checkbox"/> SDS (>15' wide) <input type="checkbox"/> Other _____	Hydraulic Application Test Method <input checked="" type="checkbox"/> Morphological Evaluation <input type="checkbox"/> Double-Ring Infiltrometer <input type="checkbox"/> Other (Specify) _____
--	--

6 Obs. # Boring Pit Ground Surface Elev. 1012.5 ft Depth to limiting factor >240 in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate
									Inches/Hr
1	0 - 11		Asphalt/Base Course		-	-	as	-	-
2	11 - 96	10 YR 4/4	None	SL/SICL (Fill)	Variable	Variable	gs	15 - 25	0.04
3	96 - 144	10 YR 4/3	None	SICL	0m	mvfr	gs	<5	0.04
4	144 - 240	7.5 YR 5/4	None	GRSL	1msbk	mvfr		15 - 25	0.5

Obs. # Boring Pit Ground Surface Elev. _____ ft Depth to limiting factor _____ in.

Horizon	Depth in.	Dominant Color Munsell	Redox Description Qu. Sz. Cont. Color	Texture	Structure Gr. Sz. Sh.	Consistence	Boundary	% Rock Frag.	Hydraulic App. Rate
									Inches/Hr

CST/PSS Name (Please Print) DAVID A STAAB	Signature	CST/PSS Number 1042602
Address 641 PIPER DRIVE, MADISON, WI	Date Evaluation Conducted 4/22/2016	Telephone Number 608/279-4530

1 SECTION 011000 - SUMMARY

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other
5 Division 01 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. In general the work consists of demolition of the existing Mount Olive Lutheran Church, adjacent single-family
8 house, and existing site improvements to make way for the construction of a new Madison Police Department
9 District Station.

- 10 B. The new Midtown District Police Station located at 4020 Mineral Point Road will be a two-story (first floor and
11 lower level) 30,000 square foot building. The Station will function as a full service police district station with a
12 Sallyport and enclosed underground parking.

- 13 C. The structural system consists of shallow concrete foundations with a multilevel structural steel superstructure
14 enclosed with a high performance building envelope comprised of masonry CMU and metal stud substrate with
15 masonry veneer, metal wall panels, insulated glass windows, and EPDM membrane roof system.

- 16 D. Mechanical, Electrical, Plumbing, Communications, Electronic Safety and Security, Fire Suppression systems will be
17 installed. The site improvements includes vehicular circulation, surface parking, landscaping, and stormwater
18 management.

- 19 E. The new building will be developed, sited and designed to include sustainable design principles emphasizing energy
20 efficiency, long-term durability and maintenance while remaining flexible and adaptable. The project shall meet a
21 minimum of a LEED Silver certified building.

22 PART 2 - PRODUCTS (Not Used)

23 PART 3 - EXECUTION (Not Used)

24 END OF SECTION 011000

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SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

1
2
3
4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS..... 1
8 2.1. SUBSTITUTION REQUEST FORM..... 1
9 PART 3 - EXECUTION 1
10 3.1. REQUESTING A SUBSTITUTION DURING BIDDING..... 1
11 3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT 2
12 3.3. UNAUTHORIZED SUBSTITUTIONS..... 2
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. The City of Madison uses a specific list of preferred products for various specification items to establish
18 standards of quality, utility, and appearance required.
19 B. The City of Madison will not allow substitutions for specified Products except as follows:
20 1. The Product is no longer produced or the product manufacturer is no longer in business.
21 2. The manufacturer has significantly changed performance data, product dimensions, or other such design
22 criteria for the specified Product(s).
23 3. Products specified by naming one or more Products or manufacturer’s and “or approved equal” or
24 “approved equivalent.”
25 C. The City of Madison will not allow substitutions for specified Products as follows:
26 1. For Products specified by naming only one Product and manufacturer, no substitute product will be
27 considered.
28 2. For Products specified by naming several Products or manufacturers select any one of the products or
29 manufacturers named, which complies with the specifications. No substitute product will be considered.
30 D. Request for substitutions from any party other than the General Contractor (GC) will not be accepted.
31

1.2. RELATED SPECIFICATIONS

- 32 A. Section 01 26 13 Request for Information (RFI)
33 B. Section 01 31 23 Project Management Web Site
34 C. Section 01 33 23 Submittals
35
36

PART 2 – PRODUCTS

2.1. SUBSTITUTION REQUEST FORM

- 39 A. During bidding all contractors (General and Sub-contractors) and suppliers of materials or products shall provide
40 hard copy of the Substitution Request form and all required attachments directly to the Project Architect.
41 Submission shall use the form located at the end of this specification.
42 1. Contractors and suppliers shall use the screen shot of the form located at the end of this specification to
43 print a hard copy for all pre-bid substitution requests.
44 B. After bidding only the GC shall submit a request and shall use the form located on the Project Management Web
45 Site.
46
47

PART 3 - EXECUTION

3.1. REQUESTING A SUBSTITUTION DURING BIDDING

- 50 A. In the event that a substitution is requested during the bidding phase the Contractor or Supplier shall meet the
51 substitution request deadline listed in the bidding documents. No substitution request will be considered during
52 the bidding period after the stated substitution request deadline. In general this procedure shall be as follows:
53 1. Submit the Substitution Request Form including all required supporting documentation to the City
54 Project Manager and Project Architect by the substitution request deadline specified in Section A of the
55 Contract Documents. Utilize the Substitution Request Form found at the end of this Section.
56 2. Submit a Substitution Request Form for each product, supported with complete data, drawings and
57 samples as appropriate, including:
58

- 1 i. Comparison of qualities of the proposed substitutions with that specified.
- 2 ii. Changes required in other elements of the Work because of the substitution.
- 3 iii. Effect on the construction schedule.
- 4 iv. Cost data comparing the proposed substitution with the Product specified.
- 5 v. Any required license fees or royalties.
- 6 vi. Availability of maintenance service and source of replacement materials.
- 7 3. The Owner and Architect will review the Substitution Request Form and if approved the City of Madison
- 8 will publish a bidding addendum authorizing the replacement. The Owner and Architect may reject any
- 9 substitution request without providing specific reasons.
- 10 B. Substitutions submitted and approved during the bidding phase shall be announced by the City of Madison by
- 11 addenda prior to the bid due date.
- 12

13 **3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT**

- 14 A. A substitution request will only be considered after award of contract if it meets the qualifying provisions as
- 15 described in 1.1.B.1 and .2 above.
- 16 B. The GC shall submit a substitution request using the digital form on the Project Management Web Site located in
- 17 the Construction Administration-Substitution Request library.
- 18 1. Click on *Add document* to open a new digital form, fill out form, provide required attachments, then click
- 19 the Submit button.
- 20 2. Consulting Staff, Owner and Owners Representatives will review the request and provide the appropriate
- 21 approvals and feed back to the GC.
- 22

23 **3.3. UNAUTHORIZED SUBSTITUTIONS**

- 24 A. Any Contractor who substitutes products without proper authorization by the Owner and Architect will be
- 25 required to immediately remove and replace the product and all costs required to conform to the Contract
- 26 Documents shall be borne by the General Prime Contractor.
- 27
- 28
- 29

30 **END OF SECTION**

31



Substitution Request

Today's Date:

Project Title:

Project Number:

Contract Number:

Description	Spec Section	Page	Paragraph
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

The undersigned requests consideration of the following:

Proposed Substitution:

Attachments

[Click here to attach a file](#)

Insert item

- Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.
- Attached data also includes a description of changes to the Contract Documents that the proposed substitution will require for its proper installation.

The undersigned General Contractor representative certifies that the following paragraphs are correct.

1. The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.
2. The proposed substitution does not affect dimensions shown on drawings.
3. The undersigned will pay for changes to the building design, including engineering design, detailing, and construction costs caused by the request.
4. The proposed substitution will have no adverse affect on other trades, the construction schedule, or specified warranty requirements.
5. Maintenance and service parts will be locally available for the proposed substitution. Provide supporting documentation.

Submitted By:

****By typing my name and entering the date I hereby give my electronic signature****

Name: Title: Date:

Firm: Address:

Phone:

1
2
3
4
5
6

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**SECTION 01 26 13
REQUEST FOR INFORMATION (RFI)**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. PERFORMANCE REQUIREMENTS..... 1
8 1.4. QUALITY ASSURANCE 1
9 PART 2 – PRODUCTS..... 1
10 2.1. REQUEST FOR INFORMATION FORM 1
11 PART 3 - EXECUTION 1
12 3.1. CONTRACTOR INITIATED RFI 2
13 3.3. RFI RESPONSES 2
14 3.4. COMMENCEMENT OF WORK RELATED TO AN RFI 2
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. Contractors shall use the RFI form/process to request additional information or clarification regarding the
20 construction documents.
21 B. All RFI documentation will be processed through the through the Construction Administration-Request for
22 Information Library on the Project Management Web Site (PMWS).
23

1.2. RELATED SPECIFICATIONS

- 24 A. Section 01 26 46 Construction Bulletin (CB)
25 B. Section 01 26 57 Change Order Request (COR)
26 C. Section 01 26 63 Change Order (CO)
27 D. Section 01 31 23 Project Management Web Site (PMWS)
28 E. Section 01 91 00 Commissioning
29

1.3. PERFORMANCE REQUIREMENTS

- 30
31 A. RFI issues initiated by any contractor shall be done through the General Contractor (GC).
32 1. RFIs submitted by any Sub-contractor under the GCs control shall be returned with no response.
33 B. Submit a new RFI for each issue. Only multiple questions that are of a similar nature may be combined into one
34 RFI shall be allowed and responded to.
35
36

1.4. QUALITY ASSURANCE

- 37 A. The GC shall be responsible for all of the following:
38 1. Ensure that any request for additional information is valid and the information being requested is not
39 addressed in the construction documents.
40 2. Ensure that all requests are clearly stated and the RFI form is completely filled out.
41 3. Ensure that all Work associated an RFI response is carried out as intended.
42 B. The PA shall be responsible for the following:
43 1. Ensure that all responses to contractor initiated RFIs are properly responded to in a timely fashion.
44 a. The CPM, Owner, consulting staff, and other City staff shall be responsible for the initial review of
45 the RFI. The PA shall be responsible for codifying all consultant and Owner/City staff comments
46 into a unified RFI response.
47
48

PART 2 – PRODUCTS

2.1. REQUEST FOR INFORMATION FORM

- 49
50
51 A. The RFI form is located on the Project Management Web Site. The GC, PA, or CPM as appropriate shall click the
52 link in the left margin of the project web site opening a new form. Project information is pre-loaded, provide
53 additional information as indicated below in the execution to complete the form.
54
55

PART 3 - EXECUTION

1 **3.1. CONTRACTOR INITIATED RFI**

- 2 A. Immediately on discovery of the need for additional information or interpretation of the Contract Documents
3 any contractor may initiate an RFI for additional information or clarification through the GC.
4 B. The GC shall select the "Submit an RFI" link on the Project Management Web Site and completely fill out the
5 form as follows:
6 1. Contract related information will be automatically populated on the form.
7 2. Thoroughly explain the issue at hand, provide backup information (photographs, sketches, drawings,
8 data, etc) as necessary, and clearly state the question or problem that requires a resolution. Combine
9 like or related issues but do not include multiple issues on one form.
10 a. Example. If a duct interferes with other critical piping and electrical work include all issues into
11 one RFI.
12 b. Example. If you have a question regarding the chiller and another regarding toilet partitions
13 create separate RFIs.
14 3. Check all relevant boxes for trades affected. This will assist the design team in determining who should
15 be reviewing the RFI.
16 C. Upon completing the RFI click the "Submit" button. The PMWS software will automatically route the RFI to the
17 appropriate reviewers.
18

19 **3.3. RFI RESPONSES**

- 20 A. Responses to simple RFI issues shall use the response section of the RFI form and shall be completed within five
21 (5) working days of the RFI form being submitted.
22 B. Responses to more complex issues may require additional time or may require a Construction Bulletin to be
23 published. The initial RFI shall be responded to within five (5) working days stating that the RFI is being
24 reviewed and provide an estimated date for the response.
25 C. The following GC generated RFIs will be returned without action:
26 1. Requests for approval of submittals
27 2. Requests for approval of substitutions
28 3. Requests for approval of Contractor's means and methods.
29 4. Requests for coordination information already indicated in the Contract Documents.
30 5. Requests for adjustments in the Contract Time or the Contract Sum.
31 6. Requests for interpretation of A/E's actions on submittals.
32 7. Incomplete RFI or inaccurately prepared RFI.
33

34 **3.4. COMMENCEMENT OF WORK RELATED TO AN RFI**

- 35 A. The GC shall only proceed with the Work of an RFI when additional information is not required.
36 B. The GC shall not proceed with any Work associated with an RFI while it is under review.
37 C. The GC shall not proceed with any Work associated with an RFI that clearly states a CB will be issued in response
38 to the RFI.
39 D. The GC will be required to immediately remove and replace unauthorized Work and all costs required to
40 conform to the Contract Documents shall be borne by the GC.
41
42
43

44 **END OF SECTION**
45
46

**SECTION 01 26 46
CONSTRUCTION BULLETIN (CB)**

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11 PART 3 - EXECUTION 2
12 3.1. WRITING THE CONSTRUCTION BULLETIN 2
13 3.2. EXECUTING THE CONSTRUCTION BULLETIN..... 2
14

PART 1 – GENERAL

1.1. SUMMARY

- 18 A. Construction Bulletins (CB) are formal published construction documents that modify the original contract bid
19 documents after construction has commenced. CBs may be published for many reasons, including but not
20 limited to the following:
21 1. Clarification of existing construction documents including specifications, plans, and details
22 2. Change in product or equipment
23 3. A response to a Request for Information
24 4. Change in scope of the contract as either an add or a deduct of work
25 B. CBs provide a higher degree of detail in response to a Request for Information (RFI) through directives, revised
26 plans/details, and specifications as necessary.
27 C. The CB may change the original contract documents through additions or deletions to the Work.
28 D. Where the directives of a CB are significant enough to warrant a Change Order Request (COR) the GC shall use all
29 information provided in the CB to assemble all required back-up documentation for additions and deletions of
30 materials, labor and other related contract costs for the COR.
31 E. All CB documentation will be processed through the Construction Administration-Construction Bulletin Library
32 on the Project Management Web Site (PMWS).
33

1.2. RELATED SPECIFICATIONS

- 34 A. Section 01 26 13 Request for Information (RFI)
35 B. Section 01 26 57 Change Order Request (COR)
36 C. Section 01 26 63 Change Order (CO)
37 D. Section 01 31 23 Project Management Web Site
38 E. Section 01 91 00 Commissioning
39
40

1.3. PERFORMANCE REQUIREMENTS

- 41 A. Project Architect (PA): The PA shall be the only person authorized to publish a CB as needed for any reason
42 indicated in section 1.1.A above. The PA shall consult as necessary with any of the following while drafting the
43 CB and shall confirm final direction with the CPM prior to issuing a CB:
44 1. City Project manager (CPM)
45 2. Owner
46 3. Members of the consulting staff
47 4. Members of city staff
48 5. The General Contractor
49 6. Sub-contractors
50 7. Commissioning Agent (CxA)
51 B. General Contractor: The GC shall be responsible for the following as needed:
52 1. Executing the directives of the CB when he/she believes that no changes in labor, materials, equipment,
53 or contract duration will be required for additions or deletions.
54 2. Submit a COR when he/she believes that a change in labor, materials, equipment or contract duration
55 will be required for additions or deletions.
56
57

1 **1.4. QUALITY ASSURANCE**

- 2 A. The PA shall be responsible for ensuring the final CB sufficiently provides direction, details, specifications and
3 other information as necessary for the GC to perform the intended Work.
4 B. The PA shall be responsible for ensuring the final CB is published as expeditiously as practical based on the
5 complexity of the CB being written. CBs that may affect the GC critical path shall be given priority.
6

7 **PART 2 – PRODUCTS**

8
9 **2.1. CONSTRUCTION BULLETIN FORM**

- 10 A. The CB form is located on the Project Management Web Site. The PA shall click the link in the left margin of the
11 project web site opening a new form. Project information is pre-loaded, the PA only needs to enter information
12 and make attachments as needed to complete the form.
13

14 **PART 3 - EXECUTION**

15
16 **3.1. WRITING THE CONSTRUCTION BULLETIN**

- 17 A. The PA shall draft a CB as needed using the Construction Bulletin form on the Project Management Web Site.
18 1. The PA and/or consulting staff as necessary shall provide specifications, model numbers and performance
19 data, details and other such information necessary to clearly state the intentions of the CB.
20 2. The consulting staff, CPM, Owner, CxA and other City Staff shall review the draft and recommend
21 changes as needed.
22 3. The PA shall amend the draft as necessary into a final CB for review
23 B. Once the final CB has been approved the PA shall “Submit” the CB through the Project Management Web Site to
24 the GC.
25

26 **3.2. EXECUTING THE CONSTRUCTION BULLETIN**

- 27 A. The GC shall acknowledge receipt of the CB on the Project Management Web Site as instructed in the Tutorial
28 Manual provided to the awarded contractor.
29 B. The GC shall notify all Sub-contractors of the CB and publish the CB to all field sets of drawings and specifications
30 as appropriate.
31 C. The GC shall execute the directives of the CB or submit COR documentation as necessary during the execution
32 and implementation of the CB.
33 1. See Specification 01 26 57 Change Order Request (COR)
34
35
36

37 **END OF SECTION**
38

**SECTION 01 26 57
CHANGE ORDER REQUESTS (COR)**

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19
20 **PART 1 – GENERAL**

21
22 **1.1. SUMMARY**

- 23 A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made
24 by the General Contractor (GC) without having prior approval of the City Engineer or his representative.
25 B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in
26 the Work by written Change Order (CO). Such changes may include additions and/or deletions.
27 C. Where the City desires to make changes in the Work through use of written Change Order Request (COR), the
28 following procedures apply:
29 1. If requested by the City, the GC shall prepare and submit a detailed proposal, including all cost and time
30 adjustments to which the GC believes it will be entitled if the change proposed is incorporated into the
31 Contract. The City shall be under no legal obligation to issue a Change Order for such proposal.
32 2. The parties shall attempt in good faith to reach agreement on the adjustments needed to the Contract to
33 properly incorporate the proposed change(s) into the Work. In the event that the parties agree on such
34 adjustments, the City may issue a Change Order and incorporate such changes and agreed to
35 adjustments, if any.
36 3. In some instances, it may be necessary for the City to authorize Work or direct changes in Work for which
37 no final and binding agreement has been reached and for which unit prices are not applicable. In such
38 cases the following shall apply.
39 a. Upon written request by the City, the GC shall perform proposed Work
40 b. The cost of such change may be determined in accordance with this specification.
41 c. In the event agreement cannot be accomplished as contemplated herein, the City may authorize
42 the Work to be performed by City forces or to hire others to complete the Work. Such action on
43 the part of the City shall not be the basis of a claim by the GC for failure to allow it to perform the
44 changed Work.
45 D. Where changes in the Work are made by the City through use of a force account basis, the GC shall as soon as
46 practicable, and in no case later than ten (10) working days from the receipt of such order, unless another time
47 period has been agreed to by both parties, give the City written Notice, stating:
48 1. The date, circumstances and source of the extra work; and,
49 2. The cost of performing extra work described by such Order, if any; and,
50 3. Effect of the order on the required completion date of the Project, if any.
51 E. The giving of each Notice by the GC as prescribed by this specification, shall be a requirement to liability of the
52 City for payment of any additional costs incurred by the GC in implementing changes in the Work. Under this
53 specification, no order or statement of the City shall be treated as a Change Order, or shall entitle the GC to an
54 equitable adjustment of the terms of this Contract or damages for costs incurred by the GC on any activity for
55 which the Notice was not given.
56 F. In the event Work is required due to an emergency as described in this specification the GC must request an
57 equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
58 commencement of such emergency.

- 1 G. All GC requests for equitable adjustment shall be submitted to the CPM per the specifications below. Such
- 2 requests shall set forth with specificity the amount of and reason(s) for the proposed adjustment and shall be
- 3 accompanied by supporting information and documents.
- 4 H. No adjustment of any kind shall be made to this Contract, if asserted by the GC for the first time, after the date
- 5 of final payment.
- 6 I. This specification shall be used by the GC when preparing documentation for any COR to ensure each has been
- 7 properly and completely filled out as required by the City of Madison.
- 8 J. All COR documentation will be processed through the Construction Administration-Change Order Request
- 9 Library on the Project Management Web Site (PMWS).

10
11 **1.2. RELATED SPECIFICATION SECTIONS**

- 12 A. Section 01 26 13 Request for Information (RFI)
- 13 B. Section 01 26 46 Construction Bulletins (CB)
- 14 C. Section 01 26 63 Change Order (CO)
- 15 D. Section 01 31 23 Project Management Web Site
- 16 E. Section 01 91 00 Commissioning
- 17 F. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public
- 18 Works Construction".
 - 19 1. Use the following link to access the Standard Specifications web page:
 - 20 <http://www.cityofmadison.com/business/pw/specs.cfm>
 - 21 a. Click on the "Part" chapter identified in the specification text. For example if the specification
 - 22 says "Refer to City of Madison Standard Specification 210.2" click the link for Part II, the Part II
 - 23 PDF will open.
 - 24 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
 - 25 to the referenced text.

26
27 **1.3. DEFINITIONS AND STANDARDS**

- 28 A. LABOR: The amount of time and cost associated with the performance of human effort for a defined scope of
- 29 Work. Labor is further defined as follows:
 - 30 1. Labor rate is the total hourly rate which includes the basic rate of pay, fringe benefits plus each
 - 31 company's cost of required insurance, also referred to as a reimbursable labor rate.
 - 32 2. Unit labor is the labor hours anticipated to install the corresponding unit of material.
 - 33 3. Labor cost is the labor hours multiplied by the hourly labor rates.
- 34 B. MATERIAL: Actual material cost is the amount paid, or to be paid, by the GC for materials, supplies and
- 35 equipment entering permanently into the Work, including cost of transportation and applicable taxes. The cost
- 36 shall not exceed the usual and customary cost for such items available in the geographical area of the project
- 37 C. LARGE TOOLS AND MAJOR EQUIPMENT: Large tools and major equipment are those with an initial cost greater
- 38 than \$1,500, whether from the GC or other sources.
 - 39 1. Tool and equipment use and time allowed is only for extra work associated with change orders.
 - 40 a. Rental Rate is the machine cost associated with operating a piece of equipment for a defined
 - 41 length of time (hour, day, week, or month) and shall not exceed the usual and customary amount
 - 42 for such items available in the geographical area of the project.
 - 43 b. Rental cost is the rental rate multiplied by the anticipated duration the equipment shall be
 - 44 required.
 - 45 2. The GC shall provide a breakdown of all rental rates to indicate what items and costs are associated with
 - 46 the rate. Examples of items to include in the breakdown would be fuel consumption, lubrication,
 - 47 maintenance and other similar expenses but not including profit and overhead.
 - 48 3. When large tools and equipment needed for Change Order work are not already at the job site, the
 - 49 actual cost to get the item there is also reimbursable.
- 50 D. BOND COST: The cost shall be calculated at 1% of the total proposed change order.
- 51 E. SUB-CONTRACTOR COSTS: Sub-contractor costs are for those labor, material, and equipment costs required by
- 52 subcontracted specialties to complete the Change Order work including allowable markups as outlined within
- 53 this specification.
- 54 F. OVERHEAD AND PROFIT Markup: The allowable markup percentage to a COR by the GC and Sub-contractors for
- 55 overhead and profit. All of the following are expenses associated with overhead and profit and shall not be
- 56 reimbursable as individual items on any COR:
 - 57 1. CHANGE ORDER PREPARATION: All costs associated with the preparing and processing of the change
 - 58 order.

- 1 2. DESIGN, ESTIMATING, AND SUPERVISION: All such efforts, unless specifically requested by Owner as
- 2 additional Work to be documented as a COR or portion thereof.
- 3 3. INSTALLATION LAYOUT: The layout required for the installation of material and equipment, and the
- 4 installation design, is the responsibility of the GC.
- 5 4. SMALL TOOLS AND SUPPLIES: The cost of small hand tools with an initial cost of \$1,500 or less, along
- 6 with consumable supplies and expendable items such as drill bits, saw blades, gasoline, lubricating or
- 7 cutting oil, and similar items.
- 8 5. GENERAL EXPENSE: The general expense, which is those items that are a specific job cost not associated
- 9 with direct labor and material such as job trailers, foreman truck, and similar items.
- 10 6. RECORD DRAWINGS: The preparation of record or as-built drawings.
- 11 7. OTHER COSTS: Any miscellaneous cost not directly assessable to the execution of the Change Order
- 12 including but not limited to the following:
- 13 a. All association dues, assessments, and similar items.
- 14 b. All education, training, and similar items.
- 15 c. All drafting and/or engineering, unless specifically requested by Owner as additional Work to be
- 16 documented as a Change Order proposal or portion thereof.
- 17 d. All other items including but not limited to review, coordination, estimating and expediting, field
- 18 and office supervision, administrative work, etc.
- 19 G. Contract Extension: The necessary amount of time to be added to the contract deadlines for the completion of a
- 20 change order.

21
22 **1.4. CONTRACT EXTENSION**

- 23 A. The GC shall not assume that every COR will require a Contract Extension. If the GC feels a contract extension is
- 24 warranted he/she shall provide sufficient scheduling information that shows how the COR being requested
- 25 impacts the critical path of the project.
- 26 B. The City of Madison strongly encourages the GC to explore alternative methods and practices prior to submitting
- 27 a COR with a request for contract extension.

28
29 **1.5. OVERHEAD AND PROFIT MARKUP**

- 30 A. Pursuant to the City of Madison Standard Specifications for Public Works Construction, Section 104.7, Extra
- 31 Work, the following maximum allowable markups shall be strictly enforced on all change orders associated with
- 32 the execution of this contract.
- 33 1. The total maximum overhead and profit shall not exceed fifteen percent (15%) of the total costs.
- 34 2. The total maximum overhead and profit shall be distributed as follows:
- 35 a. For work performed and materials provided solely by the General Contractor, fifteen percent
- 36 (15%) of the total costs.
- 37 b. For work performed and materials provided solely by Sub-contractors and supervised by the
- 38 General Contractor:
- 39 i. Supervision of the GC, five percent (5%) of the total Sub-contractor cost.
- 40 ii. Sub-contractors work and materials ten percent (10%) of the total Sub-contractor cost.

41
42 **1.6. PERFORMANCE REQUIREMENTS**

- 43 A. The GC shall become thoroughly familiar with this specification as it will identify procedures and expenses that
- 44 are or are not allowed under the Change Order and Change Order Request process.
- 45 B. The GC shall be responsible for all of the following:
- 46 1. Carefully reviewing the CB that is associated with the COR.
- 47 2. Collecting required supporting documentation from all contractors that quantify the need for a COR.
- 48 a. Labor hours and wage rates
- 49 b. Material costs
- 50 c. Equipment costs
- 51 C. The following shall apply to establishing prices for labor, materials, and equipment costs:
- 52 1. Where Work to be completed has previously been established by individual bid items in the contract bid
- 53 proposal the GC shall use the unit bid prices previously established.
- 54 2. Where Work to be completed was bid as a Lump Sum without individual bid items the GC shall provide a
- 55 breakdown of all labor, materials, equipment including unit rates and quantities required.
- 56 D. The completion date is determined by Owner. The schedule, however, is the responsibility of the GC. Time
- 57 extensions for extra Work will be considered when a schedule analysis of the critical path shows that the Change
- 58 Order Request places the Work beyond the completion date stated in the Contract.

1
2 **1.7. QUALITY ASSURANCE**

- 3 A. The GC shall be responsible for ensuring that all COR supporting documentation meets the following
4 requirements prior to completing the COR form on the Project Management Web Site:
5 1. Sufficiently indicates labor, material, and other expenses related to completing the intent of the CB.
6 2. No costs exceed the usual and customary amount for such items available in the geographical area of the
7 project, and no costs exceed those established under the contract.
8 B. The Project Architect (PA), Commissioning Agent (CxA), City Project Manager (CPM), other members of the
9 consulting staff, and city staff shall review all COR requests to ensure that the intent of the CB will be met under
10 the proposal of the COR or request additional information as necessary.
11

12 **PART 2 – PRODUCTS**

13
14 **2.1. CHANGE ORDER REQUEST FORM**

- 15 A. The COR form is located on the Project Management Web Site. The GC shall click the link in the left margin of
16 the project web site opening a new form. Follow additional instructions below in the execution section for filling
17 out the form.
18

19 **PART 3 - EXECUTION**

20
21 **3.1. ESTABLISHING A CHANGE ORDER REQUEST**

- 22 A. Upon receipt of a Construction Bulletin (CB) where the GC believes a significant change in contract scope
23 warrants the submittal of a COR the GC shall do all of the following within ten (10) working days after receipt of
24 the CB:
25 1. Review the CB with all necessary trades and sub-contractors required by the change in scope.
26 a. Additions or deletions to the contract scope shall be as directed within the CB.
27 b. Additions or deletions of labor and materials shall be determined by the GC based on the
28 directives of the CB.
29 2. Assemble all required back-up documentation for additions and deletions of materials, labor and other
30 related contract costs as previously outlined in this specification.
31 3. Submit a COR request form on the Project Management Web Site.
32 B. Submitting a COR does not obligate the GC to complete the work associated with the COR nor does it obligate
33 the Owner to approve the COR as a change to the contract.
34

35 **3.2. SUBMIT A CHANGE ORDER REQUEST FORM**

- 36 A. This specification shall provide a subject overview only. In depth instructions shall be provided to the awarded
37 Contractor in a PDF Instructional Manual.
38 B. The GC shall select the "Submit a COR" link on the Project Management Web Site.
39 C. The software will open a new COR form and the GC shall provide all of the following information:
40 1. DO NOT perform any calculations on this worksheet, only provide the raw data as requested below. All
41 calculations, totals, and markups shall be computed as described within this specification.
42 2. Provide a summary description of the COR request, and justification for any requested time extension to
43 the contract, indicate the number of calendar days being requested for the extension and add any
44 attachments to the form as needed.
45 3. Provide all GC self performance data including all of the following:
46 a. Materials description, quantities, and unit costs.
47 b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
48 c. Equipment descriptions, quantities, unit costs and rates.
49 4. Provide all Sub-contractor data including all of the following:
50 a. Materials description, quantities, and unit costs.
51 b. Labor hours and rates for all Foremen, Journeymen, and Apprentices by trade.
52 c. Equipment descriptions, quantities, unit costs and rates.
53 5. Ensure all calculations performed by the form have been completed correctly. Contact the CPM directly
54 if you suspect an error before hitting the save button.
55 C. At any time after creating a COR you must at a minimum click "Save as Draft" to save your work.
56 D. When all data has been entered and verified click on the "Submit COR" button. This will kick off the COR Review
57 and Approval process.
58

1 **3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING**

- 2 A. The PA and CPM shall review all CORs submitted by the GC.
3 1. Additional consulting staff and city staff having knowledge of the components of the COR shall review
4 and advise the PA and CPM as to the accuracy of the items, quantities, and associated costs of the COR as
5 directed by the CB.
6 2. The CPM shall review the COR with the Owner.
7 B. If required the PA and CPM, shall in good faith, further negotiate the COR with the GC as necessary. All
8 amendments to any COR shall be documented within the Project Management Web Site software.
9 C. After final review of the COR the CPM and Owner may accept the COR.
10 D. The CPM shall prepare the COR in the form of an official Board of Public Works Change Order for final review and
11 approval as outlined in Section 01 26 63 Change Order (CO).
12 E. The GC shall not act upon any accepted COR until it has received final approval through the Public Works process
13 as an official CO to the Work unless instructed to do so by the CPM. Proceeding without the final approval of a
14 fully authorized Change Order is at the GC's own risk.
15

16 **3.4. EMERGENCY CHANGE ORDER REQUEST**

- 17 A. In the event Work is required due to an emergency as described in the Contract Documents, the GC must
18 request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
19 commencement of such emergency.
20 B. The GC shall provide full documentation of all labor, materials and equipment used during the period of
21 emergency as part of the COR submittal.
22
23
24

25 **END OF SECTION**
26

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**SECTION 01 26 63
CHANGE ORDER (CO)**

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10 PART 3 - EXECUTION 2
11 3.1. PREPARATION OF THE CHANGE ORDER 2
12 3.2. EXECUTION OF THE CHANGE ORDER 2
13

14 **PART 1 – GENERAL**

15
16 **1.1. SUMMARY**

- 17 A. Except in cases of emergency, no changes in the Work required by the Contract Documents may be made
18 by the General Contractor (GC) without having prior approval of the City Project Manager (CPM).
19 B. The City may at any time, without invalidating the Contract and without Notice to Sureties, order changes in
20 the Work by written Change Order. Such changes may include additions and/or deletions.
21 C. The Change Order (CO) is a Board of Public Works (BPW) form that is reviewed and approved by a specific
22 process.
23 D. The CO form is typically made up of multiple Change Order Requests (CORs) and/or Bid Items as appropriate
24 depending on the type of project and how the contract was bid.
25 E. All CO documentation shall be processed through the Construction Administration-Change Order Library and
26 digital workflow on the Project Management Web Site (PMWS).
27

28 **1.2. RELATED SPECIFICATION SECTIONS**

- 29 A. Section 01 26 13 Request for Information (RFI)
30 B. Section 01 26 46 Construction Bulletin (CB)
31 C. Section 01 26 63 Change Order Request (COR)
32 D. Section 01 31 23 Project Management Web Site
33 E. Section 01 91 00 Commissioning
34

35 **1.3. BOARD OF PUBLIC WORKS PROCEDURE**

- 36 A. The Board of Public Works has a very explicit procedure for the review and approval of all change orders
37 associated with any Public Works Contract as follows:
38 1. The Supervisory Chain of the CPM shall review and approve any CO under \$10,000 provided it does not
39 include either of the following:
40 a. The CO does not request a time extension to the contract.
41 b. The CO does not cause the contract contingency sum to be exceeded.
42 2. The Board of Public Works shall review and approve any CO that requires any of the following:
43 a. Any CO over \$10,000.
44 b. Any CO requesting a time extension to the contract regardless of the monetary value of the CO.
45 c. Any CO that causes the contract contingency sum to be exceeded.
46 B. The Board of Public Works generally meets every other week and only once in August and December. The GC is
47 cautioned that, under normal scheduling, a CO requiring a BPW review will take a minimum of two (2) weeks to
48 achieve final approval.
49 1. The City shall not be responsible for additional delays to the Work caused by the scheduling constraints
50 of the Board of Public Works.
51 C. **SPECIAL NOTE:** The GC is cautioned to never proceed unless told to do so by the CPM. Only in rare instances
52 may the CPM give a written notice to proceed on a COR without an approved CO. Proceeding without the
53 written notice of the CPM or an approved CO is at the GC's own risk.
54

1 **PART 2 – PRODUCTS**

2
3 **2.1. CHANGE ORDER FORM**

- 4 A. The CO form is located on the Project Management Web Site. The CPM shall click the link in the left margin of
5 the project web site opening a new form. Project information is pre-loaded, the CPM only needs to enter
6 information and make attachments as needed to complete the form.
7

8 **PART 3 - EXECUTION**

9
10 **3.1. PREPARATION OF THE CHANGE ORDER**

- 11 A. The CPM shall prepare the required CO forms in the Construction Administration-Change Order Library on the
12 Project Management Web Site as follows:
13 1. Provide information for all contract information.
14 2. Provide a general description of the items described within the change order.
15 3. Provide detailed information for each Item on the CO form. At the option of the CPM he/she may include
16 multiple Change Order Requests each as their own item.
17 4. Provide required pricing and accounting information as needed for the item.
18 5. Insert attachments of contractor/architect provided information that clarifies and quantifies the CO.
19 Attachments may include but not be limited to material lists, estimated labor, revised details or
20 specifications, and other documents that may be related to the requested change.
21 6. Save the final version of the completed CO.
22

23 **3.2. EXECUTION OF THE CHANGE ORDER**

- 24 A. Upon saving the CO as described in section 3.1 above the software associated with the Project Management
25 Web Site shall notify the GC that the CO has been drafted and is ready for review. The GC shall do the following:
26 1. Open the appropriate CO form in the Construction Administration-Change Order Library and review all
27 items on the form.
28 2. The GC shall notify the CPM immediately of any errors or discrepancies on the form and shall not sign or
29 save it.
30 a. The CPM shall make any corrections as needed, re-save the form, and notify the GC.
31 3. If/when the GC concurs with the CO form as drafted the GC shall digitally sign the form and click SAVE.
32 B. After the GC digitally signs/saves the CO it shall be routed through the Project Management Web Site for
33 additional review and/or approvals. The CPM shall do the following:
34 1. Monitor the review process to ensure the software is working properly at each review step.
35 2. Ensure that proper BPW procedures are executed as needed by the CO approval process.
36 a. Schedule the CO on the next available BPW agenda if required.
37 i. Attend the BPW meeting to speak on the CO to board members and answer questions.
38 ii. The GC and/or PA may be required to attend the BPW meeting to address specific
39 information as it relates to the Work and/or materials associated with the CO.
40 3. Monitor final approval and distribution of the CO.
41 4. Notify the GC that the CO has been completed.
42 5. Ensure that the CO is posted to the next Public Works payment schedule.
43 6. Verify that the GC's next Progress Payment-Schedule of Values show the CO as part of the contract sum.
44 C. Upon final approval of the CO the GC may proceed with executing the Work associated with the CO.
45
46
47

48 **END OF SECTION**

**SECTION 01 29 73
SCHEDULE OF VALUES**

1
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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. BASIS OF VALUES 2
9 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
10 PART 3 - EXECUTION 2
11 3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT 2
12 3.2. AIA DOCUMENT G703 – CONTINUATION SHEET 2
13 3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL 3
14 3.4. SOV FOR PROGRESS PAYMENT REQUESTS 3
15

16 **PART 1 – GENERAL**

17
18 **1.1. SUMMARY**

- 19 A. The Schedule of Values (SOV) is a Contractor provided statement that allocates portions of the total contract
20 sum to various portions of the contracted work and shall be the basis for reviewing the Contractors Progress
21 Payment Requests.
22 B. AIA Document G702 – Application and Certificate for Payment and AIA Document G703 Continuation Sheet shall
23 be filled out in sufficient detail to be used as a guideline in determining work completed and materials stored on
24 site when verifying Progress Payment Requests.
25 C. The General Contractor shall be responsible for filling out, updating, and providing these work sheets with each
26 Progress Payment Request.
27

28 **1.2. RELATED SPECIFICATIONS**

- 29 A. Section 01 26 63 Change Order (CO)
30 B. Section 01 29 76 Progress Payment Procedures
31 C. Section 01 31 23 Project Management Web Site
32 D. Section 01 32 26 Construction Progress Reporting
33 E. Section 01 33 23 Submittals
34 F. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
35 Works Construction”.
36 1. Use the following link to access the Standard Specifications web page:
37 <http://www.cityofmadison.com/business/pw/specs.cfm>
38 a. Click on the “Part” chapter identified in the specification text. For example if the specification
39 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
40 PDF will open.
41 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
42 to the referenced text.
43

44 **1.3. RELATED DOCUMENTS**

- 45 A. The following documents shall be used as the basis for initiating and maintaining the SOV worksheets throughout
46 the execution of this contract.
47 1. Drawing documents and specifications (including general provisions) as provided with the bid set
48 documents and any published addendums.
49 2. Documents associated with revisions or clarifications to number 1 above after awarding of the contract,
50 including but not limited to:
51 a. Construction Bulletins
52 b. Request for Information
53 c. Approved Change Orders
54 3. The latest daily/weekly Construction Progress Report
55 4. Other specifications as identified in Section 1.2 above

1
2 **1.4. BASIS OF VALUES**

- 3 A. The Contractor shall provide a breakdown of the Contract Sum in sufficient detail to assist the Architect and City
4 Project Manager in evaluating Progress Payment Requests. The breakdown detail may require a labor and
5 material breakdown for each division of work or trade or as directed by the CPM.
6 B. The total sum of all items shall equal the Contract Sum.
7

8 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

9
10 **PART 3 - EXECUTION**

11
12 **3.1. AIA DOCUMENT G702 – APPLICATION AND CERTIFICATE FOR PAYMENT**

- 13 A. The Contractor shall use AIA Document G-702 Application and Certificate for Payment with each Progress
14 Payment Request.
15 B. Completely fill out the Project Information section as follows:
16 1. TO OWNER; provide all owner related information as provided in the contract documents.
17 2. PROJECT; provide all contract information including contract number, title and address.
18 3. FROM CONTRACTOR; provide all contractor related information.
19 4. VIA ARCHITECT; provide all the architect's related information including the architect's project reference
20 number if different from the owners.
21 5. Indicate the current APPLICATION NO., PERIOD TO date, and CONTRACT DATE.
22 C. Completely fill out the Contractors Application for Payment section.
23 1. Fill out lines 1 through 9 to reflect the current status of the contract through the payment date being
24 requested.
25 2. The City of Madison calculates retainage on Public Works Contracts as follows:
26 a. In general, across the duration of the contract, 2.5% of the total contract sum, including change
27 orders, is withheld for retainage as referenced from the City of Madison Standard Specification
28 110.2:
29 i. Beginning with Progress Payment 1, 5% retainage will be withheld until such time that 50%
30 of the total contract sum has been paid out.
31 ii. No additional retainage will be withheld after 50% of the total contract sum has been paid,
32 unless additional change orders have been approved after the 50% milestone has been
33 reached. Per City of Madison Standard Specification 110.2, additional retainage up to 10%,
34 may be held in the event there are holds placed by Affirmative Action or liquidated
35 damages by BPW.
36 iii. Retainage for additional change orders after the 50% milestone will be withheld at the rate
37 of 2.5% of the total cost of the change order.
38 iv. Retainage is based on the change orders posted to the City's contract worksheet at the
39 time the progress payment is processed.
40 D. Completely fill out the Change Order Summary section. Only change orders that have been finalized and posted
41 to the City of Madison's Application for Partial Payment worksheet may be itemized into the SOV documents.
42 E. The Contractor shall sign and date the application and it shall be properly notarized.
43 F. The Contractor shall not fill in any information in the Architects Certificate for Payment section.
44

45 **3.2. AIA DOCUMENT G703 – CONTINUATION SHEET**

- 46 A. The Contractor shall use AIA Document G-703 Continuation Sheet to itemize his/her SOV for this contract.
47 Provide additional sheets as necessary.
48 B. Provide information in Column A (Item No.), Column B (Description of Work), and Column C (Scheduled Value) by
49 any method that allocates portions of the total contract sum to various portions of the contracted work.
50 Possible methods include combinations of the following:
51 1. By division of work
52 2. By contractor, sub-contractor, sub sub-contractor
53 3. By specialty item or group
54 4. Other methods of breakdown as may be requested by the City Project Manager or City Construction
55 Manager at the pre-construction meeting.
56 C. Provide total cost of the item/description of work including proportionate shares of profit and overhead related
57 to the item.
58

1 **3.3. INITIAL SCHEDULE OF VALUES SUBMITTAL**

- 2 A. The Contractor shall upload his/her initial SOV to the Project Management Web Site, Submittals Library, no later
3 than five (5) working days after the Pre-construction Meeting.
4 1. The initial SOV shall provide information in Column A (Item No.), Column B (Description of Work), and
5 Column C (Scheduled Value) only.
6 2. The level of detail shall be as described in section 3.2 above.
7 B. The Project Architect (PA) and the City Project Manager (CPM) shall review the SOV as any other submittal and
8 may require modifications to reflect additional detail as necessary.
9 C. The Contractor shall resubmit the SOV as necessary until such time as the PPA and CPM have sufficient detail for
10 assessing and approving future Progress Payment Applications.
11 D. Progress Payment Application 1 will not be processed until such time as the Contractor has met this requirement
12 regardless of the amount of work completed per the application.
13

14 **3.4. SOV FOR PROGRESS PAYMENT REQUESTS**

- 15 A. The Contractor shall update the initial SOV with each Progress Payment Application as follows:
16 1. Initial items and values as part of Section 3.3 above will not be adjusted once the original Schedule of
17 Values submittal has been approved.
18 2. Change orders shall be added as additional items and values at the bottom of the SOV as they become
19 approved and posted to the City's contract worksheet. The value for each change order shall be the
20 value indicated on the SOV and shall stand alone. Values shall not be split out or combined with other
21 existing items with similar work descriptions on the original SOV.
22 3. Fill out Columns D, E, F and G to properly reflect the work completed and materials received since the last
23 Progress Payment Application.
24 4. Only materials delivered and stored on the project site may be reflected on SOV progress updates.
25 B. Provide updated G702 and G703 sheets with each Progress Payment application.
26 C. See Specification 01 29 76 Progress Payment Procedures for additional information on submitting Progress
27 Payment Applications.
28
29
30
31
32

END OF SECTION

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SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

1
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4 PART 1 – GENERAL 1
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6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
8 1.4. PROGRESS PAYMENT MILESTONES 1
9 1.5. PROGRESS PAYMENT SUBMITTAL 4
10 PART 2 - PRODUCTS - THIS SECTION NOT USED 4
11 PART 3 - EXECUTION 4
12 3.1. GENERAL CONTRACTOR PROCEDURE 4
13 3.2. PROJECT ARCHITECT PROCEDURE 5
14 3.3. CITY PROJECT MANAGER PROCEDURE 5
15

PART 1 – GENERAL

1.1. SUMMARY

- 19 A. The General Contractor (GC) shall review this and all related specifications prior to submitting progress payment
20 requests.
21 B. Progress payment requests (Partial Payment-PP) for this contract shall be uploaded digitally by the GC to the
22 Project Management Web Site
23 C. The Project Architect (PA) and City Project Manager (CPM) shall review and amend or approve the PP on the
24 Project Management Web Site.
25 D. After approval of the PP by the CPM, he/she shall forward the PP to the appropriate agencies for BPW
26 contractual review and payment processing.
27

1.2. RELATED SPECIFICATIONS

- 29 A. Section 01 26 63 Change Order (CO)
30 B. Section 01 29 73 Schedule of Values
31 C. Section 01 31 19 Progress Meetings
32 D. Section 01 31 23 Project Management Web Site
33 E. Section 01 32 16 Construction Progress Schedules
34 F. Section 01 32 26 Construction Progress Reporting
35 G. Section 01 33 23 Submittals
36 H. Section 01 45 16 Field Quality Control Procedures
37 I. Section 01 77 00 Closeout Procedures
38 J. Section 01 78 13 Completion and Correction List
39 K. Section 01 78 23 Operation and Maintenance Data
40 L. Section 01 78 36 Warranties
41 M. Section 01 78 39 As-Built Drawings
42 N. Section 01 78 43 Spare Parts and Extra Materials
43 O. Section 01 79 00 Demonstration and Training
44

1.3. RELATED DOCUMENTS

- 46 A. The following documents shall be used when evaluating PP requests.
47 1. Daily and weekly construction progress reports filed since the last payment request.
48 2. Contractors Schedule of Values as updated from the last payment request. See Specification 01 29 73.
49 3. Any document that may be required to be submitted for review and approval, as noted by the
50 specifications listed in Section 1.2 above, or the Progress Payment Milestone Schedule in Section 1.4
51 below, to achieve a required bench mark of contract progression or contract requirement.
52

1.4. PROGRESS PAYMENT MILESTONES

- 54 A. City Engineering-Facility Management has developed the Project Payment Milestone Schedule (Section 1.4
55 below) to assist the GC in providing required construction specific documentation and general contractual
56 documentation in a timely manner.
57 B. The Progress Payment Milestone Schedule is not an all inclusive list. Multiple agencies review progress payment
58 requests and contract closeout requests. Missing, incomplete, or incorrect documentation for any agency may

- 1 be a cause for not processing progress payments. It shall be the sole responsibility of the Contractor for
2 providing documentation as required or requested to the appropriate agencies.
- 3 C. The milestone schedule is based on the contract total sum and shall be valid for most contracts. Milestone
4 submittals will be required with whatever progress payment hits the percentage of contract total indicated in
5 the schedule.
- 6 D. The CPM shall review the milestone schedule with each progress payment request and at his/her option may
7 elect to hold processing the progress payment until such time as the contractor has met the requirements for
8 providing construction specific documentation.
- 9 E. It shall be the General Contractors responsibility to comply with all BPW Contract Administration requirements
10 and related deadlines as outlined in the Award Letter, Award Checklist, and Start Work Letter.
11

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
BPW Contract Administration Documentation <ul style="list-style-type: none"> • Workforce profiles • Best Value Contracting Documentation • Sub-contractors prequalification approval & Affirmative Action plans • Other as may be required 	PP-1, or start work as applicable	<ul style="list-style-type: none"> • For GC and Sub-contractors before PP-1 regardless of scheduling • Sub-contractors (if applicable), due 10 days before they may start work • Sub-contractors (if applicable), due 10 days before they may start work
Required Construction Submittals/Administrative Documents <ul style="list-style-type: none"> • Contractors Project Directory • Schedule of Values • Submittals Schedule • Waste Management Plan • Closeout Requirement Checklist • Warranty Checklist 	PP-1	References <ul style="list-style-type: none"> • Specification 01 31 23 • Specification 01 29 73 • Specification 01 32 19 • Specification 01 74 19 • Specification 01 77 00 • Specification 01 78 36
Construction Progress Milestones <ul style="list-style-type: none"> • Early submittals, per submittal schedule • Detailed Contract Schedules 	PP-1	See specifications for specific requirements <ul style="list-style-type: none"> • Specification 01 32 19, Examples: concrete mix, structural steel, products with long lead times • See Specification 01 32 16
General Construction Progress Requirements are all up to date <ul style="list-style-type: none"> • Progress Schedules • Submittals/Re-submittals (ongoing) • Schedule of Values • Progress Reporting • LEED Documentation • Waste Management documentation • QMOs are being addressed and closed • Progress Cleaning • As-Built Drawings 	Each future PP	Verified with each Progress Payment Request <ul style="list-style-type: none"> • Specification 01 32 16 • Specification 01 33 23 • Specification 01 29 73 • Specification 01 32 26 • All specifications with LEED documentation requirements • Specification 01 74 19 • Specification 01 45 16 • Specification 01 74 13 • Specification 01 78 39
* All of the above are being updated on the Project Management Web Site as required		
BPW Contract Administration Documentation <ul style="list-style-type: none"> • Weekly payroll reports • Best Value Contracting Reports • SBE Reports 	25% CT or PP 2	See 1.4.E above. <i>This progress payment will be with held by BPW for any missing contractual documentation.</i>

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
Construction Progress Milestones <ul style="list-style-type: none"> Construction/Contract Closeout Meeting #1 Submittals/Re-submittals complete 	50% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 33 23
Operation and Maintenance (O & M) drafts	60% CT	<ul style="list-style-type: none"> Specification 01 78 23
Construction/Contract Closeout Meeting #2 <ul style="list-style-type: none"> Construction closeout checklist 	70% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 77 00
BPW Contract Administration Documentation <ul style="list-style-type: none"> Request Finalization Review from BPW 	80% CT	<p>This is a recommendation to the GC and is not a requirement of this PP.</p> <ul style="list-style-type: none"> Specification 01 77 00
Construction Progress Milestones <ul style="list-style-type: none"> Operation and Maintenance (O & M) finals, accepted All major QMO issues resolved As-Built Drawings, Division Trades ready for GC review 	80% CT	<ul style="list-style-type: none"> Specification 01 78 23 Specification 01 45 16; Items that could prevent occupancy Specification 01 78 39
All of the following shall be completed for this PP: <ul style="list-style-type: none"> Regulatory Inspections completed All QMO reports closed Demonstration and Training completed Attic Stock completed Final Cleaning 	90% CT	<p>Contractor to determine the proper order of completion:</p> <ul style="list-style-type: none"> Governing ordinances and statutes Specification 01 45 16 Specification 01 79 00 Specification 01 78 43 Specification 01 74 13
Construction Closeout Procedures: <ul style="list-style-type: none"> Letter of Substantial Compliance sent to BI and DHS as needed Certificate of Occupancy issued As-Built Drawings, finals, accepted City Letter of Substantial Completion Warranty letters dated and issued 	100% CT	<ul style="list-style-type: none"> Specification 01 77 00 Generated/Signed by the Architect Building Inspection Specification 01 78 39 Signed by the City Engineer Specification 01 78 36
* Completion of this begins the one year warranty.		
BPW Contract Administration Documentation Contract Closeout Procedures <ul style="list-style-type: none"> Construction Closeout has been completed Contractor requests final payment of retainage upon receiving City Letter of Substantial Completion All BPW contractual requirements are verified 	Final	<ul style="list-style-type: none"> Specification 01 77 00 Contractor must provide any missing BPW Contractual Documentation
* Completion of this closes the contract but not the warranty period/bond.		
NOTE: CT = Contract Total less held retainage		

1
2 **1.5. PROGRESS PAYMENT SUBMITTAL**

- 3 A. Each progress payment submittal shall be:
- 4 1. Digital in PDF format
- 5 2. PDF shall be in color
- 6 3. Uploaded to the appropriate Project Management library and properly named per the tutorial
- 7 instructions provided to the awarded contractor.
- 8 B. Submit all required construction progress documentation to the appropriate Project Management Web Site
- 9 library.
- 10 C. In general the following shall apply to all PP requests:
- 11 1. Materials or products:
- 12 a. On order, being shipped, etc. may not be invoiced.
- 13 b. Received and stored on the project site may be invoiced.
- 14 c. Being manufactured off site at any location may not be invoiced (example: cabinetry, ductwork,
- 15 etc.)
- 16 d. Completed products stored off site locally waiting for delivery to the project site may be invoiced
- 17 with prior approval by the CPM. All of the following conditions must be met to be allowed:
- 18 i. Items must be visually inspected by CPM to verify product is complete.
- 19 ii. Item must be stored inside a compatible structure and the structure and contents must be
- 20 insured.
- 21 iii. Contractor is responsible for condition until installation is completed.
- 22 2. All labor and equipment, including rental time for the current progress period may be invoiced.
- 23 3. Only completed installations may be invoiced to 100% based on the Schedule of Values.
- 24 D. DO NOT submit BPW Contract Administration Documentation for review with Progress Payment Requests,
- 25 submit them directly to the correct agency and in the correct format as instructed from information in your BPW
- 26 Contract Award Packet instructions.
- 27

28 **PART 2 - PRODUCTS - THIS SECTION NOT USED**

29

30 **PART 3 - EXECUTION**

31

32 **3.1. GENERAL CONTRACTOR PROCEDURE**

- 33 A. The GC shall provide an updated version of his/her schedule of values (AIA documents G702 & G 703) with each
- 34 PP request.
- 35 1. The AIA - Application and Certificate for Payment (G702) shall be properly filled out and prepared for the
- 36 Architects review. See specification 01 29 73, Schedule of Values for more information.
- 37 2. The AIA - Continuation sheets (G703) shall be properly filled out and indicate the dollar value of the
- 38 completed work to date for each item on the form. See specification 01 29 73, Schedule of Values for
- 39 more information.
- 40 a. The GC shall subtotal the work completed to date for all of the original Schedule of Value items.
- 41 b. Divide the sub total of work completed by the Original Contract Total to obtain a percentage
- 42 complete of the original Lump Sum Bid. This percentage may be taken out to five (5) decimal
- 43 places (round fifth place up or down as needed).
- 44 i. Example: \$5,192.55 of completed work divided by \$10,000 original Contract Total =
- 45 0.519255, round this to 0.51926
- 46 c. Write the percentage in Column 10 on the City Tabular Sheet for the original lump sum bid item in
- 47 RED ink.
- 48 3. Ensure that any newly posted change orders from the City of Madison provided tabulation sheet have
- 49 been entered on the G703 continuation sheets. Repeat steps a thru c above for each change order on
- 50 the schedule of values and the City Tabular Sheet.
- 51 B. The GC shall fill out the City of Madison Application and Certificate of Payment cover sheet as follows:
- 52 1. The GC shall not change any pre-printed information and shall not write in the box that indicates previous
- 53 progress payments.
- 54 2. The GC shall sign and date the form where indicated.
- 55 3. The GC shall provide the dates from and to for the PP being requested.
- 56 4. The GC shall provide the list of all contractors/sub-contractors that were actively working during the
- 57 dates indicated above.

- 1 a. All contractors/sub-contractors named must be in compliance with all City requirements (Pre-qualified, Affirmative Action Plan on file, etc). The PP will be held and not processed by the City of
- 2 Madison until all contractors/sub-contractors are in compliance.
- 3
- 4 b. Do not list the names of suppliers or manufacturers, doing so will slow down processing and
- 5 require a re-submittal of the paperwork.
- 6 C. The General Contractor (GC) shall scan all of the documents listed below in the order shown, save the scan as a
- 7 single PDF file for each PP request.
- 8 1. City cover sheet – Application and Certificate for Payment
- 9 2. City tabulation sheet(s)
- 10 3. AIA G702 - Application and Certificate for Payment
- 11 4. AIA G703 - Continuation Sheet(s)
- 12 5. Any miscellaneous documents that may be requested as backup documentation for the pay request.
- 13 a. Lien waivers are not required and shall not be submitted.
- 14 b. Do not provide contractual administrative documents such as pay reports with pay requests.
- 15 c. Do not supply progress deliverables with pay requests.
- 16 F. Upload the pay request PDF to the Contract Documents-GC Partial Pay Apps library on the Project Management
- 17 Web Site.
- 18

19 **3.2. PROJECT ARCHITECT PROCEDURE**

- 20 A. The PA shall review the AIA-continuation sheets provided by the GC to determine if the Schedule of Values
- 21 accurately reflects the work completed for the inclusive dates indicated.
- 22 B. The PA shall advise the CPM of any discrepancies in the schedule of values.
- 23 C. The PA shall work with the GC and the CPM to resolve any issues prior to signing the AIA - Application and
- 24 Certificate for Payment.
- 25 D. When verified, the PA shall digitally sign the original PDF version of the AIA - Application and Certificate for
- 26 Payment on the Project Management Web Site.
- 27

28 **3.3. CITY PROJECT MANAGER PROCEDURE**

- 29 A. The CPM shall review all documents submitted by the GC and work with the PA to ensure the schedule of values
- 30 accurately reflects the work completed to date.
- 31 B. The CPM may elect to hold processing of any progress payment pending submittal of required progress payment
- 32 milestones.
- 33 C. When verified, the CPM shall digitally sign the City Cover Sheet and forward the required documentation to the
- 34 appropriate City agencies for further processing of the payment request.
- 35 D. The CPM shall add a scanned copy of any documents indicating the PP request processing was completed to the
- 36 PMWS.
- 37
- 38

39 **END OF SECTION**

40

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**SECTION 01 31 13
PROJECT COORDINATION**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 1.3. GENERAL REQUIREMENTS 1
8 1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS 2
9 1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS 2
10 PART 2 – PRODUCTS – THIS SECTION NOT USED 3
11 PART 3 – EXECUTION – THIS SECTION NOT USED 3
12

PART 1 – GENERAL

1.1. SUMMARY

- 16 A. Project Coordination covers many areas within the execution of the Contract Documents and the requirements
17 of proper coordination are the applicable to all contractors executing the Work of this contract.
18 B. This specification provides general information regarding project coordination for the General Contractor and all
19 Sub-contractors. All contractors shall be familiar with project coordination requirements and responsibilities
20 that may be defined in other specification within these Contract Documents.
21 C. The General Contractor shall at all times be responsible for the project, project site, and execution of the
22 Contract Documents.
23

1.2. RELATED SPECIFICATIONS

- 24 A. Section 01 29 76 Progress Payment Procedures
25 B. Section 01 31 19 Progress Meetings
26 C. Section 01 31 23 Project Management Web Site
27 D. Section 01 32 16 Construction Progress Schedules
28 E. Section 01 32 19 Submittals Schedule
29 F. Section 01 33 23 Submittals
30 G. Section 01 43 39 Mockups
31 H. Section 01 45 16 Field Quality Control Procedures
32 I. Section 01 60 00 Product Requirements
33 J. Section 01 77 00 Closeout Procedures, including all specifications referenced therein
34 K. Section 01 91 00 Commissioning
35
36

1.3. GENERAL REQUIREMENTS

- 38 A. The following general requirements shall applicable to all contractors:
39 1. Cooperate with the Owner, all authorized Owner Representatives, Project Architect and all consultants of
40 the Owner.
41 2. Materials, products, and equipment shall be new, as specified and to industry standards except where
42 otherwise noted.
43 3. Labor and workmanship shall be of a high quality and to industry standards.
44 B. Existing conditions:
45 1. Verify all existing conditions noted in the contract documents with actual filed locations. Verify
46 dimensions, sizes and locations, of structural, equipment, mechanical and utility components.
47 2. Report any inconsistencies, errors, omissions, or code violations in writing to the General Contractor (GC)
48 immediately.
49 3. Annotate any inconsistencies, errors, omissions on the GC As-Built record drawings immediately for
50 future reference.
51 C. Contract Documents:
52 1. The Contract Documents are intended to include everything necessary to perform the work. Every item
53 required may not be specifically mentioned, shown, or detailed.
54 a. Except where specifically stated all systems and equipment shall be complete, installed, and fully
55 operable.
56 b. If a conflict exists within the contract documents the contractor shall furnish the item, system, or
57 workmanship of the highest quality, largest, largest quantity, or most closely fits the intent of the
58 contract documents.

- 1 c. Manufacturers recommended installation details shall be verified and used prior to installation of
- 2 products and equipment so as to not void warranties.
- 3 D. Errors and Omissions
- 4 1. No Contractor shall take any advantage of any apparent error or omission in the construction documents.
- 5 2. The City of Madison shall be permitted to make such corrections and interpretations as may be deemed
- 6 necessary for the fulfillment of the intent of the construction documents.
- 7 E. Owners Representatives
- 8 1. All contractors shall be familiar with various Owner Representatives having Quality Management
- 9 responsibilities for the duration of this project including but not limited to the following:
- 10 a. Project Architect, responsible for all decisions affecting the code compliance and design intent of
- 11 the construction documents.
- 12 b. Consulting Architects and Engineers, responsible for providing consulting services to the Project
- 13 Architect, Owner, and City Project Manager, also responsible for Quality Management of the
- 14 construction documents.
- 15 c. Owner, the designated representative of the City Agency that will occupy the project upon
- 16 completion.
- 17 d. City Project Manager, responsible for all day to day decisions regarding the execution and
- 18 performance of this Public Works Contract.
- 19 e. Consulting City Staff, responsible for providing consulting services to the Project Architect, Owner,
- 20 and City Project Manager, also responsible for Quality Management of the construction
- 21 documents.
- 22 f. Commissioning Agent (CxA), responsible for ensuring that the project is meeting the Owner's
- 23 Project Requirements and related quality assurance procedures.
- 24 2. Owner Representatives shall be attending progress meetings, pre-installation meetings, performing or
- 25 being present for final testing and acceptance and quality management reporting during the execution of
- 26 the contract documents as outlined in other specifications.
- 27

28 1.4. GENERAL CONTRACTOR PERFORMANCE REQUIREMENTS

- 29 A. Assume the responsibility for all Work specified in the Contract Documents except where specifically identified
- 30 to be performed by the Owner or other contractor separately hired by the Owner.
- 31 1. Coordinate all work by Owner, equipment provided Owner, or contractor hired by the Owner into the
- 32 project schedule.
- 33 B. Provide all construction management responsibilities as specified in other Division 1 specifications including but
- 34 not limited to:
- 35 1. Scheduling of work
- 36 2. Coordination of work between other Trades and Sub-contractors
- 37 3. Construction administration and management
- 38 4. Site layout, cleanliness, and protection of completed work/stored materials
- 39 5. Waste Management
- 40 6. Quality Assurance and Quality Control
- 41 C. Use Diggers Hotline and private utility locating companies to accurately locate all public and private utilities on
- 42 the property as needed. The GC is responsible for any repair or replacement to any public or private utility
- 43 damaged during the execution of the Work
- 44 D. Report any inconsistencies, errors, omissions, or code violations in writing to the Project Architect immediately.
- 45 Failure to report inconsistencies prior to beginning work shall indicate that the GC accepted all existing
- 46 conditions.
- 47 E. The GC shall be responsible for assigning work and related responsibilities where the Contract Documents may
- 48 not clearly state who is responsible for providing the work, material, or product.
- 49 F. Provide construction management oversight of all items described in Section 1.5 below.
- 50 G. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.
- 51

52 1.5. SUB-CONTRACTOR PERFORMANCE REQUIREMENTS

- 53 A. Be familiar with all of the contract documents as they pertain to your Work, adjacent work and the overall
- 54 progress of the project.
- 55 1. All Sub-contractors shall be familiar with all Division 1 specifications as they may apply to progress,
- 56 progress payments, quality control construction management, and closeout of the contract.
- 57 B. Coordinate your Work with all adjacent work and existing conditions.

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1. Perform your work in proper sequence according to the GC's project schedule and in relation to the work of other trades.
 2. Notify other sub-contractors and trades whose work may be connected to, combined with, or influenced by your work and allow them reasonable time and access to complete their work.
 3. Join your work to the work of others in accordance with the intent of the Contract Documents.
 4. Order materials and schedule deliveries to facilitate the general progress of the Work.
- C. Cooperate with all other trades to facilitate the general progress of the work. This shall include providing every reasonable opportunity for the installation of work by others and the storage of their materials and equipment.
1. In no case shall any contractor exclude from the premises or work any Sub-contractor or their employees.
 2. In no case shall any contractor interfere with the execution or installation of Work by any other Sub-contractor or their employees.
- D. Arrange your work, equipment, and materials and dispose of your construction waste so as to not interfere with the work or storage of materials of others.
- E. Coordinate all work as indicated during pre-installation meetings with Owner Representatives, the GC and other trades. Any work improperly coordinated shall be relocated as designated by the Owner Representative at no additional cost to the City.
- F. Coordinate and assist CxA as outlined within 01 91 00 and as directed by Owner.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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SECTION SECTION 01 31 19
PROJECT MEETINGS

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14 3.4. PRE-INSTALLATION MEETINGS 3
15 3.6 PRE-CONTRACT CLOSEOUT MEETINGS 3
16 3.7 OTHER SPECIAL MEETINGS 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The purpose of this specification is to identify various project related meetings and the responsible parties for
22 scheduling, agendas, minutes, and required attendance.
23 B. This specification is not intended to be inclusive of all meeting types or a complete list of required meetings.
24 C. This specification is not intended to cover planning and execution meetings between the General Contractor
25 (GC) and his/her sub-contractors.

1.2. RELATED SPECIFICATIONS

- 28 A. 01 31 23 Project Management Web Site
29 B. 01 32 16 Construction Progress Schedules
30 C. 01 43 39 Mockups
31 D. 01 91 00 Commissioning
32

1.3. PROJECT MEETING TYPES

- 34 A. The following project meeting types may be used but not limited to the following
35 1. Preconstruction Meeting
36 2. Project Management Web Site – Tutorial Meeting
37 3. Construction Progress Meetings
38 4. Pre-installation Meetings (including mock-up review meetings)
39 5. Weekly Trade Meetings
40 6. Special Meetings
41 7. Commissioning Meetings
42

1.4. GENERAL REQUIREMENTS

- 44 A. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and
45 authorized to act on behalf of the entity each represents.
46

PART 2 – PRODUCTS – NOT USED IN THIS SECTION

PART 3 - EXECUTION

3.1. PRECONSTRUCTION MEETING

- 52 A. After execution of the Contract the City Project Manager (CPM) shall schedule and conduct the Preconstruction
53 Meeting at the Owner’s facilities. The CPM shall coordinate the meeting agenda with the Project Architect and
54 the GC Project Manager.
55 B. The CPM shall be responsible for the final agenda.
56 C. The CPM and Project Architect shall take notes on the meeting and post completed meeting minutes.
57 D. Attendance shall be required by all of the following:
58 1. Owner Representative(s)

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2. Architect and applicable sub consultant(s)
 3. General Contractor and applicable subcontractors and suppliers
 4. City Quality Management Staff
 5. Commissioning Agent
 6. Others, as may be invited for particular agenda items.
- E. Topics of the Preconstruction Meeting shall include but not be limited to the following:
1. Staff and contractor introductions
 2. Completion Date
 3. BPW Administrative requirements and due outs
 - a. Small Business Enterprise (SBE) (if applicable)
 - b. Certified payroll forms
 - c. Workforce profiles
 - d. Best Value Contracting (BVC)
 4. General Facility Management Division 1 Specifications, including:
 - a. Section 01 29 76 Progress Payment Procedures
 - b. Section 01 31 23 Project Management Web Site (overview)
 - c. Section 01 45 16 Field Quality Control Procedures
 - d. Section 01 77 00 Closeout Procedures
 - e. Section 01 91 00 Commissioning
 5. Project Meeting scheduling
 - a. Section 01 31 19 Project Meetings
 6. Construction Schedule
 7. Commissioning Process

3.2. PROJECT MANAGEMENT WEB SITE – TUTORIAL MEETING

- A. The CPM shall schedule and conduct a tutorial presentation of the PMWS prior to the beginning of construction.
- B. The CPM shall be responsible for the final agenda, there will be no minutes.
- C. The required attendance list in 3.1.D. above shall apply except for City Staff in items 1 and 4 who are already familiar with the PMWS system.
- D. It is recommended that all contractors bring their lap top, tablet or other internet capable device with them including a fully charged battery and internet connection devices as necessary.

3.3. CONSTRUCTION PROGRESS MEETINGS

- A. In general all of the following shall apply:
 1. Representatives of Contractors, Subcontractors, and suppliers attending meetings shall be qualified and authorized to act on behalf of the entity each represents.
 2. The attendance shall be from the required attendance list in 3.1.D. above.
- B. The General Contractor Project Manager (GCPM) shall:
 1. Schedule and conduct all construction progress meetings biweekly or more frequently as required.
 2. Prepare agenda for meetings including, but not limited to the following:
 - a. Safety
 - b. Current Schedule, including review of the critical path and 6-week look ahead schedule
 - c. Status of project related documentation (Submittals, RFIs, CBs, etc.)
 - d. Quality Observation Log and status of correction of deficient items
 - e. Project questions and issues from meeting attendees
 - f. BPW Administration Check
 - g. Other as needed
 - h. Status of CORs and COs to be reviewed outside the standard progress meeting time.
 3. Make physical arrangements for meetings.
 4. GCPM to post meeting agendas to the appropriate libraries on the Project Management Web Site (PMWS) no less than two (2) working days prior to the scheduled meeting. Notify all required attendees, applicable parties to the contract, and others affected of the posted meeting agenda.
 5. Preside at meetings.
 6. Route a meeting attendance roster for attendees to sign-in on.
 7. GCPM to record the minutes of the meeting; include significant proceedings and decisions. Post meeting minutes to the PMWS no more than two (2) working days after the completed meeting. Meeting minutes shall include a scanned copy of the attendance sign-in sheet. Notify all required meeting attendees, applicable parties to the contract, and others affected by decisions made at the meetings.

8. The above requirements do not apply to GC/sub-contractor meetings.

3.4. PRE-INSTALLATION MEETINGS

- A. The GCPM shall schedule and conduct all pre-installation meetings, including mockup reviews, before each construction activity that requires coordination with other trades.
- B. The GCPM shall be responsible for the final agenda and meeting minutes.
- C. The GCPM will work with all concerned parties to resolve issues as needed and submit RFI's if necessary.
- D. Required attendance shall be from the list in 3.1.D. above and shall be personnel having a stake in the outcome of the installation or knowledge of the system being installed.
- E. In the event the Contractor installs equipment or materials without a pre-installation meeting the Contractor shall be solely responsible for removing, replacing, repositioning materials and equipment as instructed by the Project Architect or City Project Manager at no additional cost to the City.

3.6 PRE-CONTRACT CLOSEOUT MEETINGS

- A. Two (2) Pre-contract Closeout Meetings shall be held to review the closeout procedures, requirements, and contract deliverables.
 - 1. Pre-contract Closeout Meeting #1 shall be scheduled prior to the 50% Progress Payment Request is being requested. This meeting shall discuss items such as closing out QMO reports, providing O&M drafts and finals, payroll and Affirmative Action documentation, and other contract deliverables.
 - 2. Pre-contract Closeout Meeting #2 shall be scheduled prior to the 80% Progress Payment Request is being requested. This meeting shall discuss, but not be limited to, the status of scheduling final regulatory inspections, cleaning up outstanding QMO's, demonstration and training, attic stock; and finalization review of payroll and other related documents.
- B. The GCPM shall schedule, coordinate, and make physical arrangements for both meetings.
- C. All of the following shall be required to attend both meetings:
 - 1. The GCPM and the GC Field superintendent
 - 2. All Subcontractor Project Managers regardless of the current status of their work.
 - a. The GCPM may excuse a Subcontractor PM if he is confident that all contractual requirements for closeout by the subcontractor have been completed and/or delivered to the GCPM. The list of attendees shall be reviewed and agreed upon with CPM ahead of the meeting.
 - b. At the option of these project managers the field supervisors may also attend.
 - 3. The Project Architect and at least one design consultant from each discipline represented by the plans and specifications to address open QMOs, final tests, reports, etc.
 - 4. The Owner
 - 5. The CPM
 - 6. Quality Management staff as needed to address open QMOs, final tests, reports, etc.
 - 7. The Commissioning Agent
- D. The CPM shall publish an agenda and chair the meeting.

3.7 OTHER SPECIAL MEETINGS

- A. The Contractor shall schedule special meetings per the requirements of the LEED Specification, the Project Quality Management Plan, the Commissioning Plan and as indicated by other specifications.
- B. Special meetings include but are not limited to the following:
 - 1. Waste Management Conference
 - 2. Equipment start up meetings
 - 3. Testing and balancing meetings
 - 4. Commissioning meetings
 - 5. Other meetings as necessitated by the contract documents

END OF SECTION

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**SECTION 01 31 23
 PROJECT MANAGEMENT WEB SITE**

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 5 1.1. GENERAL DESCRIPTION 1
 6 1.2. SHAREPOINT PROCEDURE OVERVIEW 1
 7 1.3. RELATED SPECIFICATIONS 2
 8 PART 2 - PRODUCTS 2
 9 2.1. SHAREPOINT SYSTEM RELATED PRODUCTS 2
 10 PART 3 - EXECUTION 2
 11 3.1. POST BID-OPENING 2
 12 3.2. POST PRE-CONSTRUCTION MEETING 3
 13

PART 1 – GENERAL

1.1. GENERAL DESCRIPTION

- 17 A. The City of Madison (CoM) has established a web based Project Management Tool (PMT) using a Microsoft
 18 product called SharePoint (SP).
 19 B. The software is used throughout the design, construction and warranty process of major remodels and new
 20 construction projects executed as a City of Madison, Board of Public Works project.
 21 C. Initially deployed in mid 2013, the PMT software has been successfully deployed on several projects, and we
 22 continue to modify/update/enhance the PMT on a regular basis.

1.2. SHAREPOINT PROCEDURE OVERVIEW

- 25 A. The CoM PMT is a system of consolidated Document & Form Libraries and Data Lists that assist in performing
 26 day to day functions of design/construction management while reducing the use of surface mail, email and email
 27 attachments.
 28 1. Document libraries store a wide variety of documents in many different formats including but not limited
 29 to Word, Excel, PDF, photographs (all popular formats), etc.
 30 2. Data Lists contain consolidated data information that can be generated and stored for further use. Punch
 31 Lists and Warranty issues will be examples of Data Lists.
 32 3. Form libraries contain snapshot information associated with a particular Data Entry form. An example of
 33 this is the Quality Management Observation form.
 34 B. The following libraries and sub-libraries on the PMWS are provided for specific workflows and contract
 35 documentation. Related specification numbers are in "()" if applicable.
 36

Contract Documents	Construction Administration	Construction Progress	LEED Documentation	Quality Control	Construction Closeout
<i>Signed Contract</i>	<i>Change Order Requests (COR Form) (01 26 57)</i>	<i>Schedules (01 32 16)</i>	<i>LEED Documents</i>	<i>Regulatory Inspections</i>	<i>Misc Closeout Documents</i>
<i>GC Partial Pay Apps (01 29 76)</i>	<i>Change Orders (CO Form) (01 26 63)</i>	<i>Progress Meetings (01 31 19)</i>	<i>Waste Management (01 74 19)</i>	<i>Commissioning Checklists</i>	<i>O & M Manuals (01 78 23)</i>
<i>Construction Documents</i>	<i>Construction Bulletins (CB Form) (01 26 46)</i>	<i>Daily Journal (DJ Form) (01 32 26)</i>		<i>System Performance Tests</i>	<i>Product Warranties /Guarantees (01 78 36)</i>
<i>Regulatory Documents</i>	<i>Request for Information (RFI Form) (01 26 13)</i>			<i>Quality Management Observation (QMO Form) (01 45 16)</i>	<i>As-Builts (01 78 39)</i>
<i>Testing Contract</i>	<i>Submittals (SUB Form) (01 33 23)</i>			<i>Safety and Incident Reports</i>	<i>Attic Stock (01 78 23)</i>
				<i>Material Testing & Field Reports</i>	<i>Demonstration and Training (01 79 00)</i>
					<i>Warranty Issues (WI Form) (01 78 23)</i>

- 1
2 C. A tutorial document on the web based PMT will be provided to the General Contractor (GC) who is awarded the
3 contract. Additional training will be provided as needed for the GC and Sub-Contractors (SC) by the CoM.
4 D. The PMT has predefined work flows that channel automated alerts as documents are uploaded, reviewed, and
5 completed. These workflows are designed for inbound information from the contractor as well as outbound
6 information from the Architectural/Engineer consultant and the Owner.
7 E. The GC will be required to receive email notifications, access the internet to review related documentation and
8 be able to upload/download documentation to the various project libraries.
9 F. The SC's will be required (at a minimum) to receive email notifications and access the internet to review related
10 documentation. Prior to setting up the final PMT the GC and CPM shall meet to review all SP workflows, the GC
11 will determine to what level over the minimum requirements the SC's will be involved.
12

13 1.3. RELATED SPECIFICATIONS

- 14 A. The following specification sections are directly related to the CoM PMT system.
15 1. 01 26 13 Request for Information (RFI)
16 2. 01 26 46 Construction Bulletins (CB)
17 3. 01 26 57 Change Order Request (COR)
18 4. 01 26 63 Change Order (CO)
19 5. 01 29 76 Progress Payment Procedures
20 6. 01 31 19 Project Meetings
21 7. 01 32 16 Construction Progress Schedules
22 8. 01 32 26 Construction Progress Reporting
23 9. 01 32 33 Photographic Documentation
24 10. 01 33 23 Submittals
25 11. 01 45 16 Field Quality Control Procedures (Owner)
26

27 PART 2 - PRODUCTS

28 2.1. SHAREPOINT SYSTEM RELATED PRODUCTS

- 29 A. SharePoint is a Microsoft Windows based software that requires no additional software installation, hardware or
30 other special requirements/applications for the users. There are no costs associated with the use of this system.
31 B. Currently the CoM is using SharePoint 2010.
32 1. SharePoint works best if the user's computer is running Windows versions 7 through 8.1.
33 2. SharePoint works best when used with Internet Explorer versions 7, 8 and 9 (32 bit).
34 a. At this time SharePoint is not fully supported by Internet Explorer versions 10 and 11.
35 b. At this time SharePoint is not entirely compatible with other internet browsers such as Fire Fox,
36 Google Chrome, and Safari.
37
38

39 PART 3 - EXECUTION

40 3.1. POST BID-OPENING

- 41 A. After bids have been opened, a successful bidder has been determined, and bid acceptance procedures have
42 been initiated the City Project Manager (CPM) will contact the GC to provide the following information.
43 1. Project Management Software Tutorial. This tutorial is in a PDF printable format with screen shots and
44 associated instructions on how to access and use the PMT.
45 a. Tutorial instructions will include but not be limited to the following:
46 i. Descriptions of various libraries, documents, and forms that will be used throughout the
47 construction project.
48 ii. Uploading procedures for various types of documents including standardized naming
49 conventions.
50 2. A blank Project Directory in an Excel spread sheet format. The contractor shall provide the following
51 information for GC and SC staffs as indicated on the spreadsheet. This will generally be the Project
52 Manager for the GC as well as the Sub-contractors and the GC Site Supervisor.
53 a. Last Name, First Name
54 b. Company Name
55 c. Email address (valid, work related)
56 d. Work Phone Number (required, include area code)
57 e. Cell Phone Number (not required, include area code)
58

- 1 3. The GC shall provide the above information for all SC's where the GC is not self-performing the work.
- 2 4. The GC may provide project foreperson information for work being self performed if he/she so desires.
- 3

4 **3.2. POST PRE-CONSTRUCTION MEETING**

- 5 A. The GCPM will return the completed Project Directory spread sheet to the CPM no later than the Pre-
6 construction meeting.
- 7 B. The CPM is responsible for uploading all project directory data into SharePoint and coordinating with CoM
8 Information Technology (CoM-IT) for creating the logins and passwords of non-city staff (GC/SC staffs).
- 9 C. All GC/SC staff will be notified through an automated email from CoM IT that logins and passwords are available.
10 It is the responsibility of each GC/SC to call the CoM-IT number provided in the email to receive his/her
11 login/password over the phone. Logins and passwords will not be released via email.
- 12 D. Once the GCPM has received his/her login/password uploading of contract related documents can begin. This
13 would include but not be limited to project schedules, submittals, RFI's, and other documents as needed.
- 14 E. All workflows, review of documentation, and general archiving of construction related documentation will be
15 conducted on the PMWS. These documents will generally not be emailed.
- 16 F. The following documents related to the execution of the contract will not be part of the PMWS:
 - 17 1. All documentation related to executing the contract, such as:
 - 18 a. Sub Contractors list
 - 19 b. Affirmative Action documentation
 - 20 c. Bonding documentation
 - 21 d. Documentation associated with payroll verification
 - 22 e. Final documentation associated with closing out the contract
 - 23 2. Any documentation required/generated by ordinance, code or statute, such as;
 - 24 a. Erosion Control inspections
 - 25 b. Building Inspection Department inspections
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**SECTION 01 32 16
CONSTRUCTION PROGRESS SCHEDULES**

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7 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
8 PART 3 - EXECUTION 1
9 3.1. OVERALL PROJECT SCHEDULE (OPS) 1
10 3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS) 1
11 3.3. PROJECT MANAGEMENT WEB SITE (PMWS) 2
12

PART 1 – GENERAL

1.1. SCOPE

- 16 A. This specification is to identify various project related schedules associated with indicating construction progress
17 and outlook. The following schedules are the responsibility of the General Contractor (GC).
18 1. Overall Project Schedule
19 2. 6 Week Look-out Schedule
20 B. This specification is not intended to include internal schedules generated by the contractors during their
21 planning and execution of the contract.
22

1.2. RELATED SPECIFICATIONS

- 23 A. Section 01 29 76 Progress Payment Procedures
24 B. Section 01 31 23 Project Management Web Site
25 C. Section 01 31 19 Progress Meetings
26 D. Section 01 74 13 Progress Cleaning
27 E. Section 01 77 00 Closeout Procedures
28 F. Section 01 78 23 Operation and Maintenance Data
29 G. Section 01 78 36 Warranties
30 H. Section 01 78 39 As-Built Drawings
31 I. Section 01 78 43 Spare Parts and Extra Materials
32 J. Section 01 79 00 Demonstration and Training
33 K. Section 01 91 00 Commissioning
34 L. Other specification within the construction documents that may indicate the need for scheduling any event with
35 Owner, Project Architect, Owner Representatives, including any owner provided equipment.
36
37

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL PROJECT SCHEDULE (OPS)

- 43 A. The GC shall prepare an OPS that covers the duration of the contract from the pre-construction meeting through
44 the end of construction to final contract closeout.
45 1. The GC shall review Specification 01 77 00 Closeout Procedures to become familiar with definitions,
46 differences, and requirements for closing out the construction and contract including the association with
47 progress payments.
48 B. The GC shall provide copies and lead a discussion on the OPS during the pre-construction meeting.
49 C. The OPS shall indicate start and end dates of each task associated with the project.
50 D. The OPS shall clearly indicate the critical path of the project.
51 E. The GC shall update the OPS as often as necessary during the duration of the project. Updates will be briefed as
52 needed during bi-weekly progress meetings.
53

3.2. 6 WEEK LOOK-OUT SCHEDULES (LOS)

- 54 A. The GC shall prepare the initial LOS to include detail of daily tasks for the first six (6) weeks of construction in
55 depth for the Pre-construction meeting. The LOS shall be compatible and complimentary to the OPS.
56 B. The GC shall provide copies and lead a discussion on the LOS during the pre-construction meeting.
57

- 1 C. The LOS shall indicate start and end dates of each major task, associated related sub-tasks, and required parallel
- 2 or pre-requisite tasks required to complete the major task on time.
- 3 D. The LOS shall also include identifying and scheduling such events as:
- 4 1. Pre-installation meetings and mock-up review meetings.
- 5 2. Quality management reviews of installations before they are covered.
- 6 3. Owner provided equipment as designated by the contract documents.
- 7 4. Work by others as designated by the contract documents.
- 8 5. Critical submittal dates.
- 9 E. The GC shall update the LOS prior to each bi-weekly progress meeting to indicate the next 6 weeks of scheduled
- 10 work. Updates will be briefed during each bi-weekly progress meeting.
- 11

12 **3.3. PROJECT MANAGEMENT WEB SITE (PMWS)**

- 13 A. The GC shall upload all project schedules and updates to the PMWS in an original PDF version of the scheduling
- 14 document. Scans will not be permitted.
- 15

16
17 **END OF SECTION**
18

**SECTION 01 32 19
SUBMITTALS SCHEDULE**

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8 1.4. SUBMITTAL DEFINITIONS 1
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10 1.6. ADMINISTRATIVE SUBMITTALS 2
11 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
12 PART 3 - EXECUTION 2
13 3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS 2
14 3.2. GENERAL CONTRACTORS RESPONSIBILITIES 2
15 3.3. STAFF REVIEW RESPONSIBILITIES 3
16

PART 1 – GENERAL

1.1. SUMMARY

- 20 A. The General Contractor shall submit a complete and comprehensive list of all submittals anticipated during the
21 execution of this contract.
22 B. The GC shall include the Administrative submittals identified in item 1.5 below and shall be required to up load
23 them to the Project Management Web Site.
24 C. The initial Submittals Schedule shall be based on the original contract documents used at the time of bidding and
25 any posted addenda through awarding of the contract.
26 D. The Submittal Schedule may be appended during the execution of the contract based on amendments to the
27 contract in the form of Change Orders, Construction Bulletins, and other related documents that add, or change
28 the scope of the work.
29

1.2. RELATED SPECIFICATIONS

- 30 A. Section 01 29 76 Progress Payment Procedures
31 B. Section 01 31 23 Project Management Web Site
32 C. Section 01 33 23 Submittals
33 D. Section 01 91 00 Commissioning
34
35

1.3. RELATED DOCUMENTS

- 36 A. The following documents shall be used as the basis for initiating the original Submittals Schedule.
37 1. Drawing documents and specifications (including general provisions) as provided with the bid set
38 documents and any published addenda.
39 B. The following documents shall be used to amend the submittals schedule as needed during the execution of this
40 contract.
41 1. Documents associated with revisions or clarifications to number A.1 above after awarding of the
42 contract, including but not limited to:
43 a. Construction Bulletins
44 b. Approved Change Orders
45
46

1.4. SUBMITTAL DEFINITIONS

- 47 A. Administrative Submittal: Any submittal that may be required by a Division 1 Specification and as noted in
48 Section 1.5 below.
49 B. Critical Path Submittal: Any early submittal that needs a priority review due to early construction use or long
50 lead times where a delay could affect the critical path of the construction schedule
51 C. Submittal: Any material, product, equipment, or general requirement as outlined in this and other specifications
52 that require a favorable review or acceptance prior to proceeding with procuring the item or proceeding with
53 the Work.
54
55

1.5. SUBMITTAL REQUIREMENTS

- A. The GC and all Sub-contractors shall review the construction documents including the specifications of their individual Division or Trade to compile a complete list of all materials, products, or equipment that will require a positively reviewed submittal to be completed prior to procurement and installation.
 - 1. Submittals shall include but not be limited to any of the following that may apply:
 - a. Shop Drawings
 - b. Product Data
 - c. Assembly Drawings
 - d. Engineered Drawings
 - e. Product Samples
- B. The following items will require an approved submittal, verify with specifications for specific needs and requirements:
 - 1. Contractor certifications for specialized work such as asbestos removal, well drilling, controls, AV, etc.

1.6. ADMINISTRATIVE SUBMITTALS

- A. The GC shall upload the following submittals within 15 working days of receipt of the City of Madison Start Work Letter. All Administrative Submittals shall be approved prior to requesting Progress Payment Number 1.
 - 1. Contractors Project Directory, see specification 01 31 23, discuss requirements with CPM
 - 2. Schedule of Values, see Specification 01 29 73
 - 3. Submittals Schedule, see Specification 01 32 19
 - 4. Waste Management Plan, see Specification 01 74 19
 - 5. Closeout Requirement Checklist, see Specification 01 77 00
 - 6. Warranty Checklist, see Specification 01 78 36

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. OVERALL RESPONSIBILITIES OF ALL CONTRACTORS

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of submittals to the General Contractor.
- B. Each list shall indicate the title of the submittal, the associated specification of the submittal, whether the submittal can be considered an early/middle/late submittal, the anticipated date the submittal will be provided and the anticipated date the submittal needs to be approved.
- C. Contractors shall be aware that the goals for submittal review by the Architect staff and City staff will be as follows:
 - 1. For items on the Critical Path as identified by the GC, five (5) working days
 - 2. For most other submittals ten (10) working days
 - 3. Additional time may be needed for complex submittals or if re-submittals are required.
- D. The general format of the Submittal Schedule shall be tabular as per this example:

<u>Title</u>	<u>Specification</u>	<u>Critical Path (Y or N)</u>	<u>Date provided</u>	<u>Date required</u>	<u>Remarks</u>
Concrete Mix Design	03 30 00	Y	Oct 1, 2014	Oct 15, 2014	
Paint Draw Downs	09 90 00	N	Jan 2, 2015	Jan 20, 2015	

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

- A. The General Contractor shall be responsible for all of the following:
 - 1. Consolidating all submittal lists from individual contractors into one master list.
 - 2. Reviewing all submitted lists for completeness, timing with the overall contract, etc. The GC shall meet with individual contractors to make changes as necessary.
 - 3. Upload the completed Submittals Schedule to the Submittal Library on the Project Management Web Site for review as SD 003.0. See Specification 01 33 23 Submittals for more information on this procedure.
 - 4. Resubmit the schedule as needed after initial reviews have been completed.
- B. The GC shall work with other contractors to amend the Submittals Schedule throughout the execution of the project based on changes and modifications as needed.
- C. The GC and Project Architect shall be responsible for reviewing and briefing the submittal schedule and submittals status at each bi-weekly construction meeting.

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3.3. STAFF REVIEW RESPONSIBILITIES

- A. The Project Architect, consulting staff, Commissioning Agent (CxA), Owner, and city staff will review the Submittal Schedule for completeness per the plans and specifications within their divisions of work. The reviewing staff may provide comments as needed. Some examples might include the following:
 - 1. Submittal not required
 - 2. Provide photos of samples with digital submittal
 - 3. Insure one submittal for complete system
 - 4. Append the schedule to include...
 - 5. See Specification <xyz> for additional requirements
- B. The Project Architect and City Project Manager will finalize review comments regarding the Submittal Schedule. Re-submittal of the submittal schedule may be required.

END OF SECTION

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**SECTION 01 32 26
CONSTRUCTION PROGRESS REPORTING**

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6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS 1
8 PART 2 – PRODUCTS - THIS SECTION NOT USED 1
9 PART 3 - EXECUTION 1
10 3.1. DAILY PROGRESS JOURNAL 1
11 3.2. CONSTRUCTION PROGRESS MEETINGS 2
12

PART 1 – GENERAL

1.1. SUMMARY

- 16 A. Daily records of project activities, resources used, weather conditions, and other information related to the
17 ongoing progress of the project are extremely important at all levels of Construction Management.
18 B. Daily records provide the base for weekly progress reports and updating progress schedules.

1.2. RELATED SPECIFICATION SECTIONS

- 21 A. Section 01 31 19 Project Meetings
22 B. Section 01 31 23 Project Management Web Site
23 C. Section 01 32 23 Photographic Documentation
24

1.3. PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

- 26 A. The General Contractor (GC) shall be responsible for all Construction Progress Reporting as outlined in this and
27 other specifications as noted.
28 B. The GC shall maintain daily progress journals in a format of his/her choosing provided it is legible and contains
29 the information as outlined in Section 3.1 below.
30 C. The journal shall be located in the job trailer and shall be reviewable by the Project Architect or City Project
31 Manager if so requested.
32

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. DAILY PROGRESS JOURNAL

- 38 A. The GC shall maintain a daily progress journal of daily Work activities for each day on which Work is performed
39 by any employee or entity for which the GC is responsible. Such reports shall include all relevant data
40 concerning the progress of Work activities the GC and Subcontractors are responsible for and the effect of that
41 activity on the time of performance of the Contract.
42 B. Journal entries shall be made on the Daily Work Report Form located in the Construction Progress-Daily Journal
43 Library on the Project Management Web Site. The form consists of the following areas:
44 1. Weather; include temperature, humidity, precipitation, wind and other related information such as
45 significant storm events, times, and details.
46 2. Work completed by trade
47 3. Delays encountered
48 4. Deliveries received or delayed
49 5. Hot issues that need to be addressed
50 6. Safety issues
51 7. Photograph progress and upload to the Photo Library on the Project Management Web Site.
52 8. Other including inspections, testing, etc.
53 9. Space for attaching documents
54 C. Daily Work activity reports shall be completed and signed by the GC's Job Superintendent or other on-site
55 representative authorized by the GC confirming each such report is current, accurate and complete.
56 D. If applicable the GC shall include schedules of quantities and costs, progress schedules, wage rates, reports,
57 estimates, invoices, records and other data as requested by the CPM concerning Work performed or to be

1 performed under this Contract if the CPM determines such information is needed to substantiate Change Order
2 proposals, claims, or to resolve disputes.
3

4 **3.2. CONSTRUCTION PROGRESS MEETINGS**

5 A. The GC shall provide a verbal summary of the previous two (2) weeks progress reports at each bi-weekly
6 construction progress meeting.
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8 **END OF SECTION**
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SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION

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PART 1 – GENERAL 1
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1.2. RELATED SPECIFICATION SECTIONS 1
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PART 1 – GENERAL

1.1. SCOPE

- A. The General Contractor (GC) shall be required to take weekly digital photographs of construction progress and upload the photos directly to the Project Management Web Site (PMWS).

1.2. RELATED SPECIFICATION SECTIONS

- A. Section 01 31 23 Project Management Web Site
- B. Section 01 32 26 Construction Progress Reporting

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS

- A. All digital photographs shall be taken with a good quality digital camera, cell phone, tablet, and other such digital device.
- B. Digital photographs shall be properly zoomed in/out to capture a specific level of detail as necessary.
- C. Digital photographs shall be formatted to achieve a good, clear, and detailed image where the final file size is between 600 KB and 1.2 MB (1200KB).
- D. The camera default naming convention is acceptable. The GC does not need to rename or specifically identify pictures in the title.
- E. All digital photographs shall be saved in a JPEG (.jpg) format and uploaded directly to the PMWS.

3.2. PICTURE CONTENT

- A. The GC shall take exterior photographs from at least two (2) different angles.
 - 1. This requirement shall only be applicable when there is exterior work connected with the project.
 - 2. When applicable this requirement shall begin prior to commencing any site work.
 - 3. This requirement shall end when the exterior work has been substantially completed.
 - 4. This requirement may be suspended due to weather conditions or substantial delays in exterior progress.
- B. The GC shall take interior photographs of interior construction, equipment installation, rough-ins and other such progress that helps document weekly progress reporting. Interior photographs should focus on specific significant installations as well as general progress throughout the progress of the contract.

3.3. PROJECT MANAGEMENT WEB SITE

- A. The GC shall upload the digital photographs to the appropriate progress folder in the Project Images Library.
- B. Progress folders are labeled with the Construction Week Number and the date for Monday of that week.
- C. The GC shall notify the City of Madison Project Manager if additional progress folders need to be created.

END OF SECTION

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**SECTION 01 33 23
SUBMITTALS**

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8 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
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10 3.1. GENERAL CONTRACTORS PROCEDURES 2
11 3.2. SUBMITTAL REVIEW 3
12 3.3. PROJECT ARCHITECTS REVIEW 3
13

PART 1 – GENERAL

1.1. SUMMARY

- 17 A. The General Contractor (GC) shall be responsible for providing submittals for review of all contractors and sub-
18 contractors as designated in the construction documents. Submittals shall include but not be limited to all of the
19 following:
20 1. Equipment specified and pre-approved in the specification; to ensure quality, construction, and
21 performance specifications have not changed since final design.
22 2. Equipment specified by performance in the specification; to ensure that the intended quality,
23 construction, and performance specified is met by the selected material or product.
24 3. Shop, piece, erection, and other such drawings as indicated in the specifications to ensure all structural,
25 dimensional, and assembly requirements are being met.
26 4. Submittals indicating installation sequencing
27 5. Submittals indicating control sequencing
28 6. Contractor licensing, certification, and other such regulatory documentation when required by a
29 specification.
30 7. Other submittals as may be required by individual specifications.
31 B. The submittal process shall not be used to determine alternates to specified products or equipment. All
32 considerations shall be reviewed during the bidding process and acceptable alternates shall be acknowledged by
33 addendum prior to the closing of bidding. See bidding instructions for the information on submitting alternates
34 for consideration.
35 D. In the event that a manufacturer has significantly changed a product (discontinued a model, changed dimension
36 or performance data changed available colors, etc.) since bid opening the GC shall submit a Request for
37 Information (RFI) to the Project Architect requesting other approved alternates prior to uploading a digital
38 submittal.
39 E. Contractors and sub-contractors shall be responsible for knowing the submittal requirements of ALL sections
40 within their scope of work under the contract. The Owner reserves the right to request documentation on any
41 materials, equipment, or product being installed where a submittal is not on file. If the material, equipment, or
42 product installed is determined not to meet the intent of the specification the contractor/sub-contractor shall be
43 required to remove and replace the items involved. The GC shall be solely responsible for all costs associated
44 with the removal and replacement.
45

1.2. RELATED REFERENCES

- 46 A. Section 01 29 76 Progress Payment Procedures
47 B. Section 01 31 23 Project Management Web Site
48 C. Section 01 32 19 Submittals Schedule
49 D. Section 01 32 26 Construction Progress Reporting
50 E. Section 01 91 00 Commissioning
51 F. All Technical Specifications, contract documents, construction drawings, and any published addendums during
52 the bidding process.
53 G. All contract documents generated during the execution of the contract including but not limited to Requests for
54 Information (RFI) and Construction Bulletins (CB).
55
56

1.3. SUBMITTAL REQUIREMENTS

- 57 A. A completed submittal shall meet the following requirements:
58

- 1 1. Digital submittal shall be original PDF of manufacturer's data sheets or high quality color scan of the
2 same.
- 3 a. Submittals shall not include sales fliers or other similar documents that typically do not provide
4 complete manufacturers data.
- 5 2. Documents within the PDF submittal shall be printable to a sized sheet no less than 8-1/2 by 11 inches
6 and no larger than 24 by 36 inches.
- 7 3. At the beginning of each submittal the contractor shall identify the plan reference (WC-1, EF-3, etc.) in
8 RED block letters that the submittal is for.
- 9 4. Where multiple model numbers appear in a table the contractor shall identify the specific model being
10 submitted by using a RED square, box, or other designation to distinguish the correct model from others
11 on the page.
- 12 B. A complete submittal will include all information associated with the product or equipment as presented in
13 plans, equipment tables, and specifications. Information shall include but not be limited to the following:
 - 14 1. Dimensional data
 - 15 2. Performance data
 - 16 3. Resource requirements, power, water, waste, etc
 - 17 4. Clearance and maintenance requirements
 - 18 5. Finish information, colors, textures, etc.
 - 19 6. Warranty information
- 20 C. Where a submittal includes material samples (carpet, tile, paint draw downs, etc.) the contractor shall do the
21 following:
 - 22 1. The Contractor shall submit the sample(s) as indicated in the specification.
 - 23 2. The Contractor shall include a quality photograph(s) of the product with the digital submittal.
24 Photographs shall meet the following requirements:
 - 25 a. Formatted to be between 500Kb and 1.0 Mb in file size
 - 26 b. Have no glare or flash reflection on the sample
 - 27 c. Sample fills the frame of the photo and shows detail as needed. Include multiple photos from
28 other angles as needed.
 - 29 d. Scanned copies of products or photos are not acceptable.
- 30 D. Uploaded submittals should be relative and related to a specific written specification.
 - 31 1. Do not upload submittals under a broad category or division (I.E. HVAC 23 00 00). Always upload by the
32 specific specification that identifies a required product or performance to be met.
 - 33 2. Group related items together if the specification is written that way. (I.E. all of the plumbing fixtures and
34 trim relative to one specific specification should be submitted together).
 - 35 3. Submittals shall be grouped and adhere to the divisions in the submittal schedule. Submittals that do not
36 conform to the submittal schedule and/or specification divisions will be rejected for re-submittal.

37
38 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

39
40 **PART 3 - EXECUTION**

41
42 **3.1. GENERAL CONTRACTORS PROCEDURES**

- 43 A. All required submittals will be uploaded to the Construction Administration-Submittal Drawings Library on the
44 Project Management Web Site (PMWS) by the GC.
 - 45 1. The GC shall open a new Submittal Form in the Submittals Drawings Library for each required submittal
46 from the Submittals schedule.
 - 47 2. Fill in required information on the form that will be used for routing the review and comments.
 - 48 3. Attach all documentation as described in Section 1.3 above.
 - 49 a. Submit samples under separate cover to the Project Architect when necessary.
 - 50 B. Uploading the submittal indicates that the GC has reviewed and approved the submittal against the contract
51 document requirements.
 - 52 C. The GC shall discuss submittal status at all progress meetings and shall monitor submittal review/approval/re-
53 submittal so as to not incur delays in the project schedule.
 - 54 D. A completed upload of the submittal to the PMWS initiates the review process workflow.
 - 55 E. The GC and sub-contractors shall provide re-submittals as required.
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3.2. SUBMITTAL REVIEW

- A. Upon completion of the submittal upload by the GC the PMWS automatically notifies the appropriate Architect/Engineer and Owner Representative, including CxA, by Division/Specification number that there is a submittal for review.
- B. The submittal shall be reviewed internally by the required Architect/Engineer and Owner Representative and CxA in a timely fashion and provide commentary on missing items, incorrect information, or incomplete shop drawings, etc as needed.
- C. When the internal review is completed the PMWS will notify the Project Architect the submittal is ready for final review.

3.3. PROJECT ARCHITECTS REVIEW

- A. Upon completion of the internal review the Project Architect shall review all internal review comments, confer with the CPM and CxA as needed and determine the appropriate disposition status for the submittal (approved or resubmit).
- C. The Project Architect shall summarize final internal review comments onto the submittal cover sheet, provide a final disposition of the submittal and update the review status of the submittal to “Complete...” (with or w/o comments) or “Rejected”.
- D. A completed Final Review status initiates the PMWS to notify the GC and appropriate sub-contractor(s) that the review of the submittal has been completed.

END OF SECTION

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**SECTION 01 41 00
REGULATORY REQUIREMENTS**

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8 1.4 PERMITS 2
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10 PART 3 – EXECUTION - THIS SECTION NOT USED 2
11

PART 1 – GENERAL

1.1. REQUIREMENT INCLUDED

Unless otherwise specifically directed by Contractor each Subcontractor and each Sub-subcontractor shall comply with provisions of this Section as required for proper execution and completion of their Work or portions thereof

1.2. PROCEDURES

Comply with and give notices required by applicable laws, statutes, ordinances, codes, rules, and regulations, and lawful orders of public authorities having jurisdiction applicable to performance of the Work. Comply with and give notices required by Owner’s and Contractor’s insurance companies, local utilities and labor regulations relating to the performance of the Work, the protection of adjacent property, and the maintenance of passage ways, guard fences and other protective facilities.

The Contractor shall acquire all permits, licenses, and approvals necessary for the execution of this Contract and performance of the Work and provide evidence of such applicable permits, licenses, and approvals at the Pre-Construction Meeting or before commencement of the Work.

Where Contract Documents require abatement of asbestos containing materials, prior written Notice to the State of Wisconsin, Department of Natural Resources is required. The Contractor shall provide evidence of such Notice prior to commencement of the Work.

Procure all certificates of inspection, use, and occupancy, and all permits and licenses, pay all charges and fees and give all notices necessary and incidental to the due and lawful prosecution of the Work. Certificates of inspection, use and occupancy shall be delivered to the Owner upon completion of the Work in sufficient time for occupation of the Project in accordance with the approved schedule for the Work. The costs of such procurement, payment and delivery shall be included within the Base Bid.

Exercise precaution at all times for the protection of persons (including employees) and property. Observe the safety provisions of applicable laws, building and construction codes. Refer to the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America.

It is not Contractor’s responsibility to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, and rules and regulations. However, if Contractor observes that portions of the Contract Documents are at variance therewith, Contractor shall promptly notify A/E and Owner in writing, and necessary changes shall be accomplished by appropriate Modification.

If Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities having jurisdiction, the Contractor shall assume full responsibility for such Work and shall bear the costs attributable to correction.

Refer to the Sections of the Work for referenced codes, standards, tests, etc., applicable to the Work.

1.3. NOTICES

Concealed or Unknown Conditions:

If the Contractor encounters conditions at the site are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual

1 nature, that differ materially from those ordinarily found to exist and generally recognized as inherent in construction
2 activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the
3 Owner and the Architect before conditions are disturbed and in no event later than 21 days after first observance of the
4 conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ
5 materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any of the
6 Work, will recommend and equitable adjustment in the Contract Sum or Contract Time, or both. If the Architect
7 determines that the conditions at the site are not materially different from those indicated in the Contract Documents
8 and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and
9 Contractor in writing, stating the reasons.

10
11 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers,
12 archaeological sites, or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend
13 any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the
14 Owner shall promptly take any action necessary to obtain governmental authorization required to resume operations.
15 The Contractor shall continue to suspend operations until otherwise instructed by the Owner but shall continue with all
16 other operations that do not affect those remains or features.

17
18 **1.4 PERMITS**

19 Permits, Fees, Licenses, and Inspections: Unless otherwise provided in the Contract Documents, Contractor shall secure
20 and pay for the building permit as well as for other permits, fees, licenses, inspections and approvals by government and
21 utility agencies, necessary for proper execution and completion of the Work that are customarily secured after
22 execution of the Contract and legally required at the time bids are received or negotiations concluded.

23
24 Owner will obtain plan approvals and pay all fees required by the Wisconsin Department of Safety and Professional
25 Services.

26
27 Contractor shall obtain all permits and pay all fees required by local utilities for permanent electric and gas service.

28
29 Contractor shall obtain copies of all required permits and certificates of inspection applicable to the work.

30
31 Contractor shall furnish A/E and Owner with copy of all required permits and certificates.

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33 **PART 2 – PRODUCTS - THIS SECTION NOT USED**

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35 **PART 3 – EXECUTION - THIS SECTION NOT USED**

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38 **END OF SECTION**
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**SECTION 01 43 39
MOCKUPS**

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6 1.2. RELATED SPECIFICATIONS 1
7 1.3. RELATED DOCUMENTS 1
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9 1.5. QUALITY ASSURANCE 1
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13 3.1. REVIEW THE PLANS AND SPECIFICATIONS 2
14 3.2. MOCKUP CONSTRUCTION 2
15 3.3. MOCKUP REVIEW 2
16 3.4. FINAL SUBMITTAL 3
17

PART 1 – GENERAL

1.1. SUMMARY

- A. Definition
- Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner, Owners Representative, Architect and Consultants.
 - Mockups are three dimensional, true scale models that illustrate materials and methods, equipment, workmanship, or location; based on plans, details, and assemblies.
- B. Approved mockups establish the standard of quality by which the final work will be judged.
- C. Approved mockups shall be properly documented and entered into the Submittal Library on the Project Management Web Site like any other required submittal. See section 3.4 below for more information.

1.2. RELATED SPECIFICATIONS

- A. Section 01 26 13 Request for Information (RFI)
- B. Section 01 26 46 Change Bulletin (CB)
- C. Section 01 26 63 Change Order (CO)
- D. Section 01 31 19 Project Meetings
- E. Section 01 32 16 Construction Progress Schedules
- F. Section 01 33 23 Submittals
- G. Section 01 45 00 Quality Control

1.3. RELATED DOCUMENTS

- A. The following documents shall be used for preparing mockups.
- All plans, specifications, and details including those derived as revisions (RFI, CB, CO).
 - Construction Progress Schedules. Mockups shall be done and completed in a timely fashion for review and approval so as to not impact the Contractors project schedule.
 - Any Manufacturers installation/assembly instructions.

1.4. PERFORMANCE REQUIREMENTS

- A. All Contractors shall be responsible for providing and constructing mockups as specified in their Division of Work in the plans and specifications.
- B. Materials to be used shall be as specified in the construction documents, full sized and properly assembled.
- C. Completed mockups shall be of sufficient size to provide visible detail of all components as needed for the sample.

1.5. QUALITY ASSURANCE

- A. The General Contractor (GC) shall be responsible for coordinating all of the following as needed:
- Designating the location for the mockup construction
 - Coordinating the work of all contractors and materials required to complete the mockup
 - Ensuring that the mockup meets the intent of the construction documents before scheduling the mockup review meeting.

1
2 **PART 2 - PRODUCTS**

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4 **2.1. MATERIALS**

- 5 A. The materials used in mockups shall be only those materials indicated in the plans, specifications, and favorably
6 reviewed submittals.
7 B. Mockups shall be made of full scale materials as delivered to the project site.
8 C. All materials associated with a particular detail, construction method, manufacturer's installation instructions
9 shall be properly represented and visible in the mockup. This includes but is not limited to finished mortar joints,
10 sealants, backer rods, tie bars, rebar, etc.
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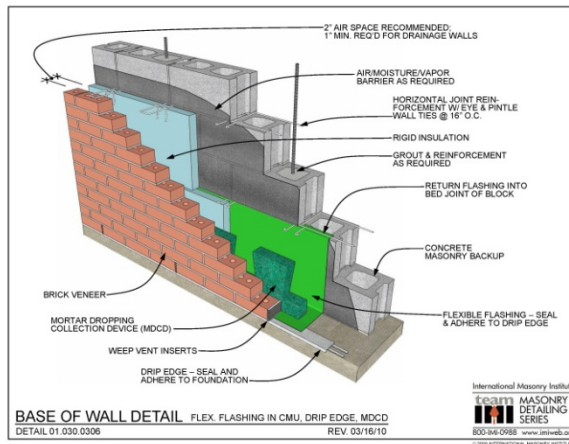
12 **PART 3 - EXECUTION**

13
14 **3.1. REVIEW THE PLANS AND SPECIFICATIONS**

- 15 A. The GC shall review the plans and specifications with all required contractors prior to constructing the mockup.
16 1. Mockups that will be built and remain in place, if favorably reviewed, will be installed in an area easily
17 accessible for review.
18 2. Mockups that will not be built in place or will not remain will be constructed in a space on the project site
19 protected from weather, construction traffic, and other such disturbances until such time as the
20 associated work has been completed.
21 3. Insure all products being represented in the mockup meet the plans, specifications, and any published
22 changes.
23

24 **3.2. MOCKUP CONSTRUCTION**

- 25 A. Mockups shall be of sufficient size to show various material adjacencies, connectivity, patterns, and other such
26 related features.
27 B. Mockups shall be constructed in a layered fashion so that all products being used can be seen and evaluated.
28 C. The construction detail below is an example of a properly layered mockup.
29



- 30
31 D. Individual mockups will be required for the following:
32 1. Complete air/moisture/vapor barrier system to assure integrity and completeness of entire systems for
33 approval by the Project Architect prior to the any system being hidden from view by any facing materials.
34 2. Complete exterior flashing system, including over roof areas, to assure integrity and completeness of
35 entire flashing systems for approval by the Project Architect prior to the any system being hidden from
36 view by any facing materials.
37 3. Stone veneer panel for approval by the Project Architect prior to the start of production installation of
38 the stone veneer.
39 4. Face brick panel for approval by the Project Architect prior to the start of installation of the installation of
40 the face brick.
41 5. Exterior metal panel area for approval by the Project Architect prior to the start of the production
42 installation of the exterior metal panels.
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3.3. MOCKUP REVIEW

- A. The General Contractor and all associated Sub-contractors (Contracting Team) shall meet with the Owner, Owners Representative, Architect and Consultants (Design Team) as necessary to review the mock-up. Contractors shall be prepared to answer questions on materials and methods as necessary.
- B. The Contracting and Design Teams shall review the mockup in detail for materials, methods, and workmanship with respect to the intent of the contract documents. Improvements or adjustments shall be discussed as needed.
- C. If the mockup is incomplete or does not show sufficient detail of products and workmanship the General Contractor shall resubmit a new mockup.
- D. Re-submittal of mockups to meet the intent of the contract documents shall be the responsibility of the General Contractor. No Change Orders will be processed for additional time or materials associated with re-submitting a mockup for approval.
 - 1. In the event that a submitted mockup meets the criteria of the contract documents but does not meet the expectations of the design team and alternative methods or materials are discussed the following procedure shall be used:
 - a. Project Architect shall publish a Construction Bulletin (CB) to detail the required/recommended changes.
 - b. The GC shall prepare and submit a new mockup.

3.4. FINAL SUBMITTAL

- A. The field approved mockup shall be submitted by the General Contractor as any other submittal for project documentation purposes. The mockup submittal shall consist of the following:
 - 1. Digitally photograph the field approved mockup. Take as many detailed photos as necessary to capture the complexity of the mockup.
 - 2. Provide a written summary of the approved mockup. Include all recommended adjustments, level of expected workmanship, and other such detail as discussed during the mockup review.
 - 3. Submit the mockup to the Project Management Web Site. See Specification 01 33 23 Submittals for additional information.

END OF SECTION

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SECTION 01 45 16
FIELD QUALITY CONTROL PROCEDURES

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PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract
22 signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are
23 delivered for the contracted Work.
24 1. The Progress Management Web Site is a Construction Management tool that provides contractors and
25 staff a single on-line location for the daily operations and progression of the Work.
26 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it
27 progresses. The City of Madison does not use a “Punch List” or “Corrections List” as it is typically known
28 throughout the construction industry. The QMO process acts as an “in progress punch list”.
29 a. By using the QMO process the City of Madison’s goal is to have a zero item punch list prior to the
30 90% progress payment and owner occupancy.
31 B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related
32 specifications identified therein to become familiar with the terminology and expectations of this City of
33 Madison Public Works contract.
34 C. It is the intent of this specification to outline the requirements, expectations, and responsibilities of the General
35 Contractor (GC), Project Architect, and other representatives of the Owner for items of Quality Assurance and
36 Quality Control.
37 1. This specification is not intended to conflict with Specification 01 40 00 Quality Requirements or other
38 specifications requiring testing and inspecting services.
39 2. This specification does not relieve the GC from any requirements associated with regulatory inspections
40 performed by the City of Madison Building Inspection Unit, or inspectors from other agencies as required
41 by code.
42 3. Any testing performed by an Owner’s Representative does not relieve the GC from performing any
43 testing that may be required by the construction documents.
44

1.2. RELATED SPECIFICATION SECTIONS

- 46 A. Section 01 26 13 Request for Information (RFI)
47 B. Section 01 29 76 Progress Payment Procedures
48 C. Section 01 31 13 Project Coordination
49 D. Section 01 31 23 Project Management Web Site
50 E. Section 01 40 00 Quality Requirements
51 F. Section 01 77 00 Closeout Procedures
52 G. Section 01 78 13 Completion and Correction List
53 H. Section 01 91 00 Commissioning
54

1.3. PERFORMANCE REQUIREMENTS

- 56 A. All contractors shall be responsible for a proper quality assurance/quality control (QA/QC) program throughout
57 the execution of the Work defined within the construction documents, including all recognized construction
58 industry standards and all applicable regulatory codes.

- 1 B. The GC shall be responsible for all of the following:
2 1. Monitor the quality of all workmanship, supplies, materials, and products being installed by all
3 contractors and installers to ensure they meet or exceed the minimum requirements set forth by the
4 construction documents.
5 2. Submit a Request for Information (RFI) whenever manufacturers' instructions or referenced standards
6 conflict with the construction documents before proceeding with the Work.
7 3. Ensure that Work requiring special certifications or licensing is being performed by is being performed
8 and supervised by personnel that meet the appropriate requirements.
9 a. Ensure that all certificates and licenses are current throughout the execution of the project.
10 C. The CoM and its representatives shall perform quality assurance and quality control activities throughout the
11 execution of this project. This in no way relieves the GC of maintaining an acceptable QA/QC program. =
12

13 **1.4. QUALITY ASSURANCE**

- 14 A. The GC shall be responsible for the following:
15 1. All materials, equipment, and products shall be new, clean, undamaged, and meet the performance
16 specifications defined within the construction documents including favorably reviewed submittals.
17 a. Any material, equipment, or product that does not meet the requirements of the construction
18 documents shall be removed and replaced, including any adjacent and related work, at the GCs
19 expense.
20 2. All Work shall be performed by persons properly trained and/or qualified to produce workmanship of the
21 quality specified in the construction documents.
22 3. Providing access to updated as-builts, addenda, submittals, bulletins and other related construction
23 documents at the project site.
24 B. The CoM and its representatives may be responsible for any of the following:
25 1. Attend pre-installation meetings
26 2. Attend construction progress meetings
27 3. Review all submittals
28 4. Conduct field visits for QA/QC purposes, provide feedback to the GC and sub-contractors using Quality
29 Management Observation (QMO) reports.
30 5. Review delivered equipment
31 6. Witness equipment installations, startups, testing as specified in other specifications
32

33 **1.5. QUALITY MANAGEMENT OBSERVATION REPORT**

- 34 A. The Quality Management Observation report or QMO is used as a QA/QC tool by those entities responsible for
35 QA/QC activities, including but not limited to, the GC, CoM, PA, CX agent, etc.
36 B. QMOs are designed to be an early observation of non-conforming construction work before it becomes buried
37 by follow on work. As such it is most often used as an "in progress punch list".
38 C. QMO forms are part of the Quality Control Library on the Project Management Web Site.
39

40 **PART 2 – PRODUCTS - THIS SECTION NOT USED**

41
42 **PART 3 - EXECUTION**

43
44 **3.1. QUALITY MANAGEMENT RESPONSIBILITIES**

- 45 A. While making routine progress visits to the construction project the GC, CPM, CxA and A/E, and applicable others
46 shall observe the details of the construction and installations to ensure that the intent of the construction
47 documents is being followed.
48 B. If during the progress visit there is a determination of contract non-conformance a QMO report shall be initiated
49 to begin the documentation process.
50 1. The GC field superintendent shall be informed immediately of any issue that may cause harm, damage to
51 finished work, or be buried prior to properly filing a QMO report.
52 C. The following information when filing a QMO report:
53 1. Open a QMO report in the Quality Control Library on the Project Management Web Site
54 2. Enter the date and time of the field visit
55 2. Provide references to construction documents if any (examples; specification, drawing page, details,
56 approved submittals, RFI, CB, etc)
57 3. Provide a short title for the observation being made
58 4. Provide a detailed description of the observation being made

- 1 5. Select all categories (Sitework, Structure, Enclosure, Interior, etc) from the given list that may apply to
- 2 the observation being reported.
- 3 a. For each category selected additional boxes shall open with contractor names associated with
- 4 each category.
- 5 6. Select all contractors from the lists provided that may need to be aware of the observation.
- 6 7. Provide any attachments that may help provide reference to the observation.
- 7 8. Click the SAVE button before closing the form.
- 8 D. The software for the Project Management Website will email notifications that a QMO report has been initiated.
- 9 The software will automatically select and notify the following:
- 10 1. The GC, PA, and CPM for all observation reports being filed.
- 11 2. Others depending on the observation categories selected.
- 12 3. Contractors based on the selections made in the sub-contractors lists.

13
14 **3.2. RESPONDING TO A QMO**

- 15 A. All contractors receiving email notification of a QMO Observation shall review the details of the observation.
- 16 B. The GC shall be responsible for determining the course of action required to remedy the non-conforming issue
- 17 and shall coordinate and direct the contractor(s) responsible for any work related to the observation.
- 18 C. All contractors assigned to remedy the observation by the GC shall provide follow-up responses on the QMO
- 19 report as follows:
- 20 1. Open the QMO report in the Quality Control Library on the Project Management Web Site.
- 21 2. In the "Follow-Up Response" area enter a description of your follow-up response in the box provided.
- 22 a. Click "Insert Item" if additional boxes are required.
- 23 3. Add attachments (pictures) if needed to show the work has been completed.
- 24 4. Click the SAVE button before closing the form.

25
26 **3.3. GENERAL CONTRACTORS FOLLOW-UP**

- 27 A. The GC shall inspect the work to ensure that all assigned contractors have remedied the observation to the
- 28 intent of the construction documents.
- 29 B. The GC shall respond with any additional comments in his/her response box.
- 30 1. If no comments are to be made the GC at a minimum must date the response box to trigger the next
- 31 work flow.
- 32 C. Click the SAVE button before closing the form.
- 33 D. The software will email a notification to the CPM and the person who initiated the QMO that the issue has been
- 34 remedied.

35
36 **3.4. QMO CLOSEOUT PROCEDURE**

- 37 A. The person who initiated the QMO shall review the remedied work and if properly corrected shall close and date
- 38 the QMO form.
- 39 1. Click SAVE and the software will email a notification to the CPM that final review of the Observation is
- 40 required.
- 41 2. In the event there are still issues the Quality Manager can add additional comments in the response area,
- 42 click SAVE and re-issue the QMO for additional review as needed.
- 43 B. Once the person who initiated the QMO has closed the item the CPM shall review and verify with the PA that the
- 44 Observation has been properly remedied and provide final closure on the QMO.

45
46 **3.5. CONSTRUCTION CLOSEOUT**

- 47 A. The GC shall note that successful close out QMOs are required for construction closeout as follows:
- 48 1. Certain progress payments as identified in Specification 01 29 76 are contingent QMO reports being properly
- 49 closed out.
- 50 2. Specification 01 77 00 defines all construction closeout requirements.

51
52
53
54 **END OF SECTION**

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SECTION 01 45 29
TESTING LABORATORY SERVICES

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PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

- 18 A. The Contractor shall employ and pay for the services of an independent testing laboratory to perform specified
19 services and testing.
20 B. Testing Laboratory inspection, sampling and testing is required for:
21 1. Section 03 30 00: Cast-In-Place Concrete
22 2. Section 05 12 00: Structural Steel Framing
23 3. Section 05 40 00: Cold-Formed Steel Framing
24 4. Section 31 20 00: Earthwork
25

1.2. RELATED REQUIREMENTS

- 27 A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders or
28 approvals of public authorities.
29 B. Related Requirements Specified in Other Sections:
30 1. Division 22 and 23: Testing of Mechanical Systems
31 2. Division 26: Testing of Electrical Systems
32

1.3. QUALIFICATION OF LABORATORY

- 34 A. Meet “Recommended Requirements of Independent Laboratory Qualification” published by American Council of
35 Independent Laboratories.
36 B. Meet basic requirements of ASTM E 329, “Standards of Recommended Practice for Inspection and Testing
37 Agencies for Concrete and Steel as Used in Construction.”
38 C. Authorized to operate in State in which the Project is located.
39

1.4. LABORATORY DUTIES

- 41 A. Cooperate with Owner, A/E and Contractor; provide qualified personnel after due notice.
42 B. Perform specified inspections, sampling and testing of materials and methods of construction:
43 1. Comply with specified standards.
44 2. Ascertain compliance of materials with requirements of Contract Documents.
45 C. Promptly notify the Owner, A/E and Contractor of observed irregularities or deficiencies of work or products.
46 D. Promptly submit written report of each test and inspection; one copy each to A/E, Consulting Engineer, Owner
47 and Contractor. Each report shall include:
48 1. Date issued.
49 2. Project Title and number.
50 3. Testing laboratory name, address and telephone number.
51 4. Name and signature of laboratory inspector.
52 5. Date and time of sampling or inspection.
53 6. Record of temperature and weather conditions.
54 7. Date of test.
55 8. Identification of product and specification section.
56 9. Location of sample or test in the Project.
57 10. Type of inspection or test.
58 11. Results of tests and compliance with Contract Documents.

- 1 12. Interpretation of test results, when requested by A/E or the Contractor.
2 E. Perform additional tests as required by Owner, A/E or the Contractor.
3
4 **1.5. LIMITATIONS OF AUTHORITY OF TESTING LABORATORY**
5 A. Laboratory is not authorized to:
6 1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
7 2. Approve or accept any portions of the Work other than those portions of the Work scheduled for testing.
8 3. Perform any duties of the Contractor.
9
10 **1.6. CONTRACTOR'S RESPONSIBILITIES**
11 A. Cooperate with laboratory personnel, provide access to Work and to manufacturer's operations.
12 B. Secure and deliver to the laboratory, adequate quantities of representative samples of materials proposed to be
13 used and which require testing. Submit concrete mix designs to A/E for approval prior to pouring concrete.
14 C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other material mixes
15 that require control by the testing laboratory.
16 D. Furnish copies of Product test reports as required.
17 E. Furnish incidental labor and facilities:
18 1. To provide access to Work to be tested.
19 2. To obtain and handle samples at the Project site or at the source of the product to be tested.
20 3. To facilitate inspections and tests.
21 4. For storage and curing of test samples.
22 F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and
23 scheduling of tests.
24 G. Make arrangements with laboratory and pay for additional samples and tests required for Contractor's
25 convenience.
26 H. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform
27 additional inspections, sampling and testing required when initial tests indicate work does not comply with
28 Contract Documents.
29 I. Temporarily halt the progress of the Work when tested materials do not comply with Contract Documents and
30 promptly notify the Owner or his designated representative and A/E.
31 J. Remove and replace at no cost to the Owner, all defective materials discovered upon testing not to comply with
32 Contract Documents, including cost for retesting and re-inspecting replaced Work that failed to comply with the
33 Contract Documents.
34
35 **1.7. SPECIFIC TEST, INSPECTIONS, AND METHODS REQUIRED**
36 A. **Section 03 30 00: Cast-In-Place Concrete**
37 1. Secure sample of aggregates Contractor proposes to use and test for compliance with Specifications.
38 2. Certify compliance with Specifications of cement proposed for use by the Contractor.
39 3. Review and approve the Contractor's proposed concrete mix proportions for the required concrete
40 strengths using materials Contractor proposed to use on the project. Incorporate specified admixtures
41 and not less than amounts of cement specified.
42 4. Perform appropriate laboratory tests, including compression tests of cylinders and slump test to
43 substantiate mix designs.
44 5. Inspect and test materials during concrete work to substantiate compliance with Specifications and mix
45 requirements.
46 a. Testing:
47 i. Sample and test concrete in accordance with ASTM C 31, ASTM C 143, ASTM C 172, and
48 ASTM C 231.
49 ii. Perform slump tests in accord with ASTM C 143 from same concrete batch used for test
50 cylinders and record results and comments on compression test reports.
51 iii. Perform compression tests in accordance with ASTM C39.
52 iv. When air-entrained concrete is used, a minimum of one (1) air content test shall be
53 performed in accordance with ASTM C 231 for each set of test cylinders taken.
54 v. Identify all test cylinders with symbols to indicate location on the job where concrete test
55 was made. Record on project record drawings.
56 vi. Strength tests shall be made for: each day's pour; each class of concrete; each change of
57 supplies or sources; and for each 100 cubic yards of concrete or fraction thereof.

- 1 vii. One slump test shall be made for each set of test cylinders taken following the procedure
- 2 in ASTM C 143.
- 3 b. Test Cylinders for all Concrete
- 4 i. Each test shall consist of a minimum of four cylinders.
- 5 ii. Make test cylinders in conformity with ASTM C 31.
- 6 iii. After 24 hours three cylinders to be carefully transported to the testing laboratory for
- 7 moisture curing and one cylinder to be field cured.
- 8 iv. One field cured cylinder to be tested at 7 days and two laboratory cured cylinders to be
- 9 tested at 28 days. Reserve one cylinder for further testing.
- 10 v. The average of all strength tests representing each class of concrete, as well as the average of
- 11 any three consecutive strength tests for each class of concrete, shall be equal to or
- 12 greater than the specified strength.
- 13 vi. If the A/E has reason to believe that cylinder strength tests are not representative of the
- 14 strength of concrete in place, A/E shall require drilled cores to be cut and tested at the
- 15 Contractor’s expense. Coring and testing shall be in accordance with ASTM C 42 Standard
- 16 Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- 17 B. **Section 05 12 00: Structural Steel Framing**
- 18 1. Welding:
- 19 a. Provide inspection of shop and field welding in accordance with Section 6 of AWS D1.1.
- 20 b. Visually inspect all welds, perform appropriate non-destructive tests on apparent defective welds.
- 21 Verify conformance with Specifications.
- 22 c. Non-destructive testing shall be performed on 20 percent of the total length of all full penetration
- 23 welds. If a sufficient number of welds are deficient, additional testing may be performed at the
- 24 discretion of the testing lab, at no cost to Owner.
- 25 2. Bolting:
- 26 a. Visually inspect all connections for proper number, size and type of bolt.
- 27 b. Review all bolted connections for compliance with “snug tight” requirements of AISC.
- 28 c. No Slip-critical (SC) connections/bolts are required for this project.
- 29 d. Shear Connectors, Headed/Deformed Bar Concrete Anchors:
- 30 i. Verify pre-production test records for installation of shear connectors, concrete anchors
- 31 and threaded studs.
- 32 ii. Shear connectors shall be struck with a hammer. Those not producing a “clean” pinging
- 33 sound indicative of a fully attached shear connector shall be bent 15 degrees off vertical
- 34 towards the nearest support by striking with a hammer. If shear connector does not
- 35 become loose and weld is not broken, it shall be considered acceptable, and shall be left in
- 36 the bent position. Replace failing shear connectors and test as before.
- 37 iii. A visual inspection shall be made of shear connectors and headed/deformed bar concrete
- 38 anchors after installation. If visual inspection reveals that a sound weld and a 360 degree
- 39 flash has not been obtained, the connector/anchor shall also be tested by bending a
- 40 minimum of 15 degrees off vertical opposite to the missing weld/flash, irrespective of the
- 41 results of the “ping” test required for shear connectors. If the connector/anchor does not
- 42 become loose it shall be considered acceptable and shall be left in this position. Replace
- 43 failing connector/anchors and inspect as before.
- 44 C. **Section 05 40 00: Cold Formed Steel Framing**
- 45 1. As directed by A/E, Contractor’s testing agency may inspect the maintenance of a quality control program
- 46 including spot checking weldments and welding procedures in accordance with AWS standards.
- 47 D. **Section 31 20 00: Soil Compaction Control and Trenching and Backfilling**
- 48 1. Soils Engineer to be onsite during excavation operation.
- 49 2. Visually inspect, test, and certify that exposed undisturbed underlying soil is suitable for required footing
- 50 bearing capacity and placement of fills.
- 51 3. Maximum and minimum density of fill soil for compaction percentage of relative density and moisture
- 52 density shall be determined in accordance with ASTM Designation D 1557. Testing agency will test
- 53 compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937,
- 54 as applicable.
- 55 4. Number of tests as follows:
- 56 a. Subgrade, Undisturbed and Demolition Surfaces: Visual inspection and probe; test if required.
- 57 b. Interior Fills: One test per 2,500 sq. ft for each two foot or less lift.
- 58 c. Exterior Fills: One test per 2,500 sq. ft for each two foot or less lift.

1 d. Utility Trenches: One test per 50 lineal feet for each two foot or less lift.
2

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PART 2 – PRODUCTS – THIS SECTION NOT USED

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PART 3 – EXECUTION – THIS SECTION NOT USED

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END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

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27

PART 1 – GENERAL

1.1. SUMMARY

- 30
31 A. This Section includes general procedural requirements for temporary facilities and controls including, but not
32 limited to the following:
33 1. Temporary Utilities
34 2. Telecommunications Services
35 3. Temporary Sanitary Facilities
36 4. Barriers
37 5. Fencing
38 6. Exterior Enclosures
39 7. Security
40 8. Vehicular Access and Parking
41 6. Waste Removal
42 7. Project Identification
43 8. Field Offices
44

1.2. RELATED SPECIFICATION SECTIONS

- 45
46 A. Section 01 31 19 Progress Meetings
47 B. Section 01 31 23 Project Management Web Site
48 C. Section 01 74 19 Construction Waste Management and Disposal
49

1.3. QUALITY ASSURANCE

- 50
51 A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having
52 jurisdiction, including but not limited to:
53 1. Building Code requirements
54 2. Health and safety regulations
55 3. Utility company regulations
56 4. Police, Fire Department and Rescue Squad rules
57 5. Environmental protection regulations
58 6. Joint Commission - Hospital Accreditation Standards

- 1 B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition
2 Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA
3 Electrical Design Library "Temporary Electrical Facilities".
4 C. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service.
5 Install service in compliance with NFPA 70 "National Electric Code".
6

7 **1.4. TEMPORARY UTILITIES**

- 8 A. Contractor will provide the following:
9 1. Temporary electrical power for construction.
10 2. Temporary water supply for construction.
11 a. Use trigger-operated nozzles for water hoses, to avoid waste of water.
12 3. Temporary heating including fuel or electric.
13 B. Temporary Lighting: Electrical Contractor shall provide temporary lighting with local switching.
14 1. Install and operate temporary lighting, minimum of 30 fc, to fulfill security and protection requirements,
15 without operating the entire system, and will provide adequate illumination for all areas of work,
16 including construction operations and traffic conditions.
17 F. Temporary Heat: General Contractor shall provide temporary heat required by construction activities, for curing
18 or drying of completed installations or protection of installed construction from adverse effects of low
19 temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed
20 installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition
21 required and minimize consumption of energy.
22 1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-
23 contained LP gas or fuel oil heaters with individual space thermostatic control.
24 a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is
25 prohibited.
26

27 **1.5. TELECOMMUNICATIONS SERVICES AND WI-FI**

- 28 A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization through
29 construction closeout.
30 B. Telecommunications services shall include:
31 1. Windows-based personal computer dedicated to project telecommunications.
32 2. Shared access to the internet via WIFI or similar wireless connection.
33 a. Access must be capable to support minimum of <10> wireless devices.
34 3. Email Account/address dedicated for GC Project Manager of GC Supervisor on site.
35

36 **1.6. TEMPORARY SANITARY FACILITIES**

- 37 A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
38 B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and
39 maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
40 1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide
41 covered waste containers for used material.
42 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
43 C. Maintain daily in clean and sanitary condition
44 D. Water: Provide potable water approved by local health authorities
45

46 **1.7. BARRIERS**

- 47 A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be
48 hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from
49 construction operations and demolition.
50

51 **1.8. FENCING**

- 52 A. Construction: Refer to Plan Documents and Specification Section 01 76 00: Fencing Materials and Barricades
53

54 **1.9. EXTERIOR ENCLOSURES**

- 55 A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions
56 and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures
57 identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors
58 with self-closing hardware and locks.

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1.10. SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.11. VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.

1.12. WASTE REMOVAL

- A. See Section 01 74 19 - Waste Management, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.13. PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated in Section 01 58 13.
- B. Erect on site at location determined by Owner.
- C. No other signs are allowed without Owner permission except those required by law.

1.14. FIELD OFFICES

- A. Office: Weather tight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Field Office shall be located within the project limits.
- C. Provide space for Project Meetings with table and chairs to accommodate a minimum of <fifteen (15)> persons.
- D. Provide a minimum of a 42" LCD monitor or other digital projection device to be connected to the computer identified in Section 1.5 Telecommunications Services (above), for use during progress meetings in connection with reviewing construction progress information posted to the Project Management Web Site (Specification 01 31 23) hosted by the Owner.

PART 2 - PRODUCTS

2.1. TEMPORARY PARTITIONS

- A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise.
 - 1. Non-fire rated partitions, standard
 - a. Wood stud framing, 6-mil polyethylene

2.2. EQUIPMENT

- A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting materials and employees.
- B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
- C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
- D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
- E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.

- 1 F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.
- 2 G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA
- 3 recommended classes for the exposures, extinguishing agent and size required by location and class of fire
- 4 exposure.
- 5

6 **PART 3 - EXECUTION**

7

8 **3.1. TEMPORARY FIRE PROTECTION**

- 9 A. Until fire protection needs are supplied by permanent facilities, General Contractor shall install and maintain
- 10 temporary fire protection facilities of the types needed to protect against reasonably predictable and
- 11 controllable fire losses.
- 12 B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding
- 13 Construction, Alterations and Demolition Operations".
- 14 C. Locate fire extinguishers where convenient and effective for their intended purpose.
- 15 D. Store combustible materials in containers in fire-safe locations.
- 16 E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways
- 17 and other access routes for fighting fires.
- 18 F. Prohibit smoking on the premises.
- 19 G. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition
- 20 according to requirements of authorities having jurisdiction.
- 21 H. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site
- 22 I. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods
- 23 and procedures. Post warnings and information.
- 24

25 **3.2. COLLECTION AND DISPOSAL OF WASTE**

- 26 A. Collect waste from construction areas and elsewhere daily
- 27 B. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce
- 28 requirements strictly.
- 29 C. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to
- 30 rise above 80 deg F.
- 31 D. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing
- 32 properly. Dispose of material in a lawful manner.
- 33

34 **3.3. ENVIRONMENTAL PROTECTION**

- 35 A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply
- 36 with environmental regulations, and minimize the possibility that air, waterways and subsoil might be
- 37 contaminated or polluted, or that other undesirable effects might result.
- 38 B. Avoid use of tools and equipment which produce harmful noise.
- 39 C. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms
- 40 near the site.
- 41

42 **3.4. REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS**

- 43 A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.
- 44 B. Remove underground installations to a minimum depth of 2 feet (600 mm). Grade site as indicated.
- 45 C. Clean and repair damage caused by installation or use of temporary work.
- 46 D. Restore existing facilities used during construction to original condition.
- 47 E. Restore new permanent facilities used during construction to specified condition.
- 48
- 49

50

51 **END OF SECTION**

**SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE**

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7 1.3. SUBMITTALS 1
8 PART 2 - PRODUCTS 1
9 2.1. SIGN MATERIALS 1
10 2.2. PROJECT IDENTIFICATION SIGN 1
11 PART 3 - EXECUTION 1
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14

PART 1 – GENERAL

1.1. SECTION INCLUDES

- A. Project identification sign.

1.2. QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
B. Sign Painter: Experienced as a professional sign painter for minimum three years.
C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.3. SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements for submittal procedures.
B. Shop Drawing: Show content, layout, lettering, color, structure, sizes.

PART 2 - PRODUCTS

2.1. SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate.
B. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4" thick, standard large sizes to minimize joints.
C. Rough Hardware: Galvanized

2.2. PROJECT IDENTIFICATION SIGN

- A. One painted sign, 32 sq ft area, bottom 6 feet above ground.
B. Content:
1. Project title, Midtown District Police Station, City of Madison Police Department, City of Madison logo, Madison Police Department logo, and name of Owner as indicated on Contract Documents.
2. Names and title of Architect.
3. Name of Prime Contractor.
4. Full color project rendering from high resolution image as furnished by Architect.

PART 3 - EXECUTION

3.1. INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
B. Erect at designated location.
C. Install sign surface plumb and level, with butt joints. Anchor securely.

3.2. REMOVAL

- A. Remove sign, framing supports, and foundations at completion of Project and restore the area.

END OF SECTION

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**SECTION 01 60 00
PRODUCT REQUIREMENTS**

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18

PART 1 – GENERAL

1.1. SUMMARY

- 22 A. The purpose of this specification is to provide general guidelines and responsibilities related to the receiving,
23 handling, and storage of all materials and products from arrival on the job site through installation.
24 1. Immediate inspection of delivered goods means a timely replacement if damaged.
25 2. Proper storage helps prevent damage and loss by weather, vandalism, theft, and job site accidents.
26 3. Proper storage helps with job site performance and safety.
27 2. Proper handling helps prevent damage and job site accidents.
28 B. Each Contractor shall be directly responsible for the receiving, handling, and storage of all materials and
29 products associated with the Work of their Division or Trade.
30 C. Each Contractor responsible for Work associated with Owner provided materials or products shall be responsible
31 for the receiving, handling and storage of the material/product as outlined in Section 3.8 below..
32

1.2. RELATED SPECIFICATIONS

- 34 A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
35 Works Construction”.
36 1. Use the following link to access the Standard Specifications web page:
37 <http://www.cityofmadison.com/business/pw/specs.cfm>
38 a. Click on the “Part” chapter identified in the specification text. For example if the specification
39 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
40 PDF will open.
41 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
42 to the referenced text.
43 c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
44 B. Section 01 57 21 Indoor Air Quality
45 C. Section 01 74 13 Progress Cleaning
46 D. Section 01 76 00 Protecting Installed Construction
47 E. Other Divisions and Specifications that may address more specifically the requirements for the storage and
48 handling of materials and products associated Work of other Divisions or Trades.
49

1.3. QUALITY ASSURANCE

- 51 A. The GC shall be responsible for ensuring that these minimum storage and handling requirements are met by all
52 contractors on the project site including but not limited to the following:
53 1. Receiving deliveries of materials, products, and equipment.
54 a. Inspect all deliveries upon arrival for damage, completeness, and compliance with the
55 construction documents.
56 i. Deliveries shall remain in original packaging or crates, shipping manifest shall be kept with
57 the delivery and the packaging shall have visible identification of the items within the
58 packaging.

- 1 b. Immediately report any damaged products or equipment to the GC, begin arrangements for
2 immediate replacement.
- 3 c. Materials or equipment that have been damaged, are incomplete, or do not comply with the
4 construction documents shall not be permitted to be installed.
- 5 2. All materials and products shall be stored within the designated limits of the project site. Only store the
6 amount of material necessary for upcoming operations so as not to interfere with other construction
7 activities and access to Work by the Owner and Architect. Any offsite storage shall be at the expense of
8 the contractor storing the material or product. All offsite storage requirements shall comply with this
9 specification. All offsite storage of materials is subject to Owner Representative Quality Management
10 review at any time.
- 11 3. Large storage containers may be used but shall be weather tight, securable, placed on concrete blocks,
12 timbers, or jack stands and shall be level.
- 13 4. When lifting equipment is required the equipment rating shall be greater than the loading requirements
14 of the item being lifted. In addition all of the following shall apply as necessary:
15 a. Only designated and/or designed lift points shall be used.
16 b. Large items shall have tag lines and handlers at all times during lifting operations.
17 c. Lift at multiple points as needed to prevent bending.
- 18 5. Materials and products stored inside of the structure shall comply with all of the following:
19 a. Storage shall not be allowed to impede the flow of work in progress.
20 b. Storage shall not be allowed to hide completed work from review and inspections.
21 c. Storage shall not exceed the design loads of the structural components it is being stored upon.
- 22 6. All materials and products shall be stored according the manufacturers minimum recommended
23 requirements. All of the following shall be considered before storing any product or material:
24 a. Dust and dirt
25 b. Moisture and humidity, including rain and snow
26 c. Excessive temperatures, direct sun, etc
27 d. Product or material weight and size
28 e. Potential for breakage
29 f. Product incompatibility with other products such as corrosiveness, chemical reactions,
30 flammability, etc.
31 g. Product or material value and replacement cost
- 32 7. The Contractor shall be responsible for providing fully functional tarps or plastic wrap, to protect
33 materials and products from the weather. All coverings shall be free of large holes and tears, and shall be
34 tied, strapped, or weighted down to resist blowing.
- 35 8. The Contractor shall be responsible for any temporary heating, cooling, or other utility requirement that
36 may be associated with the storage of a material or product.
- 37 9. The Contractor shall be responsible for securing materials and products of value such as copper, A/V
38 equipment, etc. Such items shall be stored in securable shipping containers, job trailers or other such
39 storage devices. Container shall be kept secured when not in use.
- 40 B. The GC shall inspect the job site daily to ensure that all products and materials stay weather tight and are
41 secured against vandalism or theft as required by this specification.
- 42 C. The Owners Representative may at any time request improvements regarding storage of any material or product
43 being provided under these construction documents.
- 44

45 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

46

47 **PART 3 - EXECUTION**

48

49 **3.1. GENERAL CONTRACTOR REQUIREMENTS**

- 50 A. Designate material storage and handling areas as needed including all of the following:
51 1. Designate specific areas of the site for delivery and storage of materials to be used during the execution
52 of the Work.
53 2. Designated areas shall not be located so as to interfere with the installation of any Work including Work
54 by others such as the installation of utilities or the maintenance of existing utilities. This shall include not
55 storing items in active utility easements as designated by the site plan.
- 56 B. Arrange for openings in the building as needed to allow delivery and installation of large items. Openings shall
57 be appropriately sized to include the use of booms, slings, and other such lifting devices that may be larger than
58 the item being installed.

- 1 1. When openings are required in completed Work (new or existing) the GC shall be responsible for
2 providing an appropriate opening and for restoring the opening to the original or better condition upon
3 completion. Restoration shall be weather tight and complete.
4 C. Repeated moving and handling of items being stored shall not be allowed. The GC shall be responsible for any
5 damage and replacement because of mishandling or excessive handling.
6

7 **3.2. BULK MATERIAL**

- 8 A. Bulk material such as sand, gravel, top soil and other types of fill shall be stored away from the construction area
9 and shall be stock piled as follows:
10 1. All bulk material shall be piled safely and efficiently in as small an area as practical. Only store the
11 amount of material necessary for upcoming operations so as not to interfere with other construction
12 activities and access to Work by the Owner and Architect.
13 2. All stock piles shall have silt fence/sock properly installed around the perimeter to prevent erosion and
14 loss of material. Refer to City of Madison Standard Specification Section 210.1(f) and other related
15 specification or details.
16 3. Fine grained material shall be protected with tarps to prevent blowing. Tarps shall be weighted or staked
17 to stay in place.
18 B. Bulk material such as brick, concrete block, stone, and other palletized materials shall be stored on original
19 shipping pallets until ready for use.
20

21 **3.3. DRY PACKAGED MATERIAL**

- 22 A. Dry packaged material such as cement, mortar, etc shall be stored on pallets, on slightly elevated ground or clear
23 stone pad to keep water away from the base of the material being stored. Protect from moisture.
24

25 **3.4. STRUCTURAL AND FRAMING MATERIAL**

- 26 A. All structural and framing material shall be stored in an organized manner arranged by type, size and dimension.
27 Materials shall be stored on pallets or timbers as necessary and shall not be allowed to lie directly on the ground.
28 B. Long and heavy items shall be supported at several points to prevent bending and warping.
29

30 **3.5. EQUIPMENT**

- 31 A. Equipment delivered to the site shall be stored away from all construction activities until the item can either be
32 moved inside or properly installed.
33 B. Equipment shall be stored on slightly elevated ground or clear stone pad to keep water away from the base of
34 the equipment.
35

36 **3.6. FINISH PRODUCTS**

- 37 A. Finish products such as flooring, tile, counters, lockers, toilets, partitions, lighting, and other similar items should
38 not be delivered and stored until the structure has been enclosed, is weather tight, temperature controlled and
39 the contractor is ready for such items to be installed.
40 1. Storage of finished products outside for any length of time shall not be allowed.
41 B. Products that cannot be stored inside the structure shall be stored in secured containers or job trailers until such
42 time as they are ready to be installed.
43 C. Products with a high potential for breakage such as glass, mirrors, tiles, toilet fixtures, etc. shall be stored with
44 additional protection as necessary such as but not limited to the following:
45 1. Store in original shipping containers until ready for installation.
46 2. Do not store in high traffic areas.
47 3. Shield with other materials such as cardboard, plywood, or similar products.
48

49 **3.7. DUCTWORK, PIPING, AND CONDUIT**

- 50 A. All piping and conduit shall be stored horizontally unless otherwise specified by the manufacturer or Division and
51 Trade Specifications.
52 1. Do not store directly on grade.
53 2. Cover metal pipes and tubes to prevent rust and corrosion, allow ventilation to prevent condensation.
54 3. Whenever possible use pipe stands for storing pipe and conduit to prevent tripping and rolling hazards.
55 B. All ductwork shall be stored horizontally or vertically as necessary unless otherwise specified by the
56 manufacturer or Division and Trade Specifications.
57 1. During storage, both ends of each duct shall be protected with plastic sheathing to prevent dust and dirt
58 from getting inside the duct. Sheathing shall be sufficiently taped to the duct.

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2. After installation, free/open ends shall remain protected with taped plastic sheathing and or temporary filters as specified by division or Trade specifications.
- 3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT**
- A. Section 3.8.A. shall apply to all equipment being provided to any contractor directly from the Owner for installation under the contract.
- 1. The Owner or Owners Representative shall do the following:
 - a. Inspect all deliveries upon receipt and notify manufacturer of any issues directly.
 - b. Review the received shipment with the contractor.
 - i. Only provide products or materials to the contractor that were not damaged through shipping or handling.
 - ii. Confirm missing products or materials and anticipated delivery schedule if known.
 - 2. The Contractor responsible for the installation of Work associated with Owner provided materials or products shall “take ownership” and provide safe and secure storage and handling as previously described within this specification.
 - i. The Contractor shall be liable for the repair or replacement of any material or product damaged after taking ownership of the product from receipt through final acceptance.
- B. Section 3.8.B. shall apply to all equipment being provided by the Owner but shipped directly to any sub-contractor or the project site for installation under the contract.
- 1. The GC and/or Contractor responsible for the Work associated with the Owner provided materials or products shall do the following:
 - a. Inspect all deliveries upon receipt and notify the Owner or Owners Representative of any issues directly.
 - i. Owner or Owners Representative shall notify manufacturer of any issues directly.
 - b. Review the received shipment with the Owner or Owners Representative
 - i. Confirm missing products or materials and anticipated delivery schedule if known.
 - 2. The Contractor shall “take ownership” and provide safe and secure storage and handling as previously described within this specification.
 - i. The Contractor shall be liable for the repair or replacement of any material or product damaged after taking ownership of the product from receipt through final acceptance.

END OF SECTION

**SECTION 01 71 23
FIELD ENGINEERING**

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12

PART 1 – GENERAL

1.1. REQUIREMENTS INCLUDED

- A. The Contractor shall provide and pay for field engineering services required for the Project:
1. Land surveying services required to execute the Work, to include building addition location and layout, and location and layout of pavements and all proposed site improvements.
 2. Verification of existing building dimensions, elevations, and relationship to proposed additions.
 3. Professional Engineering services to execute Contractor’s construction methods.
 4. Registered Professional Engineer in the State of Wisconsin to determine the load capacity of the existing structure for use of Contractors’ temporary facilities, equipment, lifts, machinery, material storage, etc.

1.2. RELATED REQUIREMENTS

- A. Conditions of the Contract

1.3. PROCEDURES

- A. A property survey has been prepared for the Owner and has been bound with Contract Drawings. Surveys shall describe physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. If information is incomplete, notify Owner to furnish additional information. Verify easement locations, front, side, and rear yard restrictions, if any; and property line locations. Verify control points, and establish bench marks. Locate and layout roads, walks, parking areas and all civil structures and all proposed site improvements.
- B. Verify locations of underground services, utilities, structures, etc. which may be encountered or affected by the Work.

1.4. PROJECT SURVEY REQUIREMENTS

- A. Using datum, the lot lines and present levels have been established as indicated on the Drawings. Other grades, lines, levels and benchmarks, shall be established and maintained by the Contractor, who shall be responsible for them. As work progresses, the Contractor shall layout on forms and floor, the locations of all partitions, walls and fix column centerlines as a guide to all trades. The Contractor shall make provision to preserve property line stakes, benchmarks, or datum point. If any are lost, displaced or disturbed through neglect of any Contractor, Contractor’s agents or employee, the Contractor responsible shall pay the cost of restoration.
- B. Establish lines and levels, locate and layout, by instrumentation and similar appropriate means, additions, column locations, floor levels, stakes for walks, etc.
- C. Provide data to all Subcontractors for their use as applicable.
- D. From time to time, verify layouts by same methods.

1.5. RECORDS

- A. Maintain a complete, accurate log of all control and survey work as it progresses.

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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**SECTION 01 73 29
CUTTING AND PATCHING**

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12 PART 3 - EXECUTION 2
13 3.1. EXAMINATION 2
14 3.2. PREPARATION 2
15 3.3. PERFORMANCE 2
16 3.4. CLEANUP AND RESTORATION 3
17

PART 1 – GENERAL

1.1. SUMMARY

- 20
21 A. This Section includes general procedural requirements for cutting and patching including, but not limited to the
22 following:
23 1. Examination
24 2. Preparation
25 3. Performance
26 4. Cleanup and Restoration
27

1.2. RELATED SPECIFICATION SECTIONS

- 28
29 A. Divisions 02 through 32 Sections for specific requirements and limitations applicable to cutting and patching
30 individual parts of the Work.
31 B. Division 07 Section "Penetration Fire Stopping" for patching fire-rated construction.
32

1.3. DEFINITIONS

- 33
34 A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
35 B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other
36 Work.
37 C. Level Alpha
38

1.4. QUALITY ASSURANCE

- 39
40 A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying
41 capacity or load-deflection ratio.
42 B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results
43 in reducing their capacity to perform as intended or that may result in increased maintenance or decreased
44 operational life or safety.
45 C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that
46 could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that
47 may result in increased maintenance or decreased operational life or safety. Some miscellaneous elements
48 include the following:
49 1. Water, moisture, or vapor barriers
50 2. Membranes and flashings
51 3. Exterior curtain-wall construction
52 4. Equipment supports
53 5. Piping, ductwork, vessels, and equipment
54 6. Noise and vibration control elements and systems
55 D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and
56 patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that
57 would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has
58 been cut and patched in a visually unsatisfactory manner.

1 **1.5. WARRANTY**

- 2 A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting
3 and patching operations, by methods and with materials so as not to void existing warranties.
4 B. All cutting and patching work performed under this contract shall be warranted like new work as defined by the
5 Specification governing the work.
6

7 **PART 2 - MATERIALS**

8
9 **2.1. GENERAL**

- 10 A. Comply with requirements specified within other sections of the Specifications.
11 B. In-Place Materials: Use materials identical to existing in-place materials. For exposed surfaces use materials that
12 visually match in-place adjacent surfaces to the fullest extent possible.
13 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the
14 visual and functional performance of in-place materials.
15

16 **PART 3 - EXECUTION**

17
18 **3.1. EXAMINATION**

- 19 A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
20 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including
21 compatibility with in-place finishes or primers.
22 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.
23

24 **3.2. PREPARATION**

- 25 A. Temporary Support: Provide temporary support of Work to be cut.
26 B. Protection: Protect in-place construction and existing conditions during cutting and patching to prevent damage.
27 Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting
28 and patching operations. If the failure to protect or the lack of protection, of in-place construction and/or
29 existing conditions results in damage, the contractor shall be responsible for repair to previous condition.
30 C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
31 D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be
32 removed, relocated, or abandoned, bypass such services/systems before cutting to eliminate interruption to
33 occupied areas.
34

35 **3.3. PERFORMANCE**

- 36 A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the
37 earliest feasible time, and complete without delay.
38 1. Cut in-place construction to provide for installation of other components or performance of other
39 construction, and subsequently patch as required to restore surfaces to their original condition.
40 B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations,
41 including excavation, using methods least likely to damage elements retained or adjoining construction. If
42 possible, review proposed procedures with original Installer; comply with original Installer's written
43 recommendations.
44 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and
45 chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance
46 of adjacent surfaces. Temporarily cover openings when not in use.
47 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
48 3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
49 4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by
50 cutting and patching operations.
51 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap,
52 valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other
53 foreign matter after cutting.
54 6. Proceed with patching after construction operations requiring cutting are complete.
55 C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following
56 performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and
57 comply with installation requirements specified in other Sections.

1 D. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of
2 installation.
3

4 **3.4. CLEANUP AND RESTORATION**

- 5 A. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a
6 manner that will eliminate evidence of patching and refinishing.
- 7 1. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - 8 2. Restore damaged pipe covering to its original condition.
 - 9 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another,
10 patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish,
11 color, texture, and appearance. Remove in-place floor and wall coverings and replace with new
12 materials, if necessary, to achieve uniform color and appearance.
 - 13 4. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch
14 and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats
15 until patch blends with adjacent surfaces.
 - 16 5. Ceilings: Patch, repair, or re-hang in-place ceilings as necessary to provide an even-plane surface of
17 uniform appearance.
 - 18 6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weather tight
19 condition.
 - 20 7. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint,
21 mortar, oils, putty, and similar materials.
 - 22 8. Any smoke and fire caulking that has been disturbed must be replaced by the Contractor as required by
23 code.
24

25
26
27 **END OF SECTION**
28

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**SECTION 01 74 13
PROGRESS CLEANING**

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PART 1 – GENERAL

1.1. SUMMARY

- 20 A. Throughout the execution of this contract all contractors shall be responsible for maintaining the project site in a
21 standard of cleanliness as described in this specification.
22 B. All contractors shall also comply with the requirements for cleaning as described in other specifications.
23 C. Work included in this specification shall include but not be limited to:
24 1. Safety Cleaning
25 2. Project Site Cleaning
26 3. Progress Cleaning
27 4. Final Cleaning
28

1.2. RELATED SPECIFICATIONS

- 30 A. Section 01 35 00 Special Procedures
31 B. Section 01 60 00 Product Requirements
32 C. Section 01 74 19 Construction Waste Management and Disposal
33 D. Section 01 76 00 Protecting Installed Construction
34

1.3. QUALITY ASSURANCE

- 36 A. The General Contractor (GC) shall conduct daily inspections, more often if necessary, of the entire project site to
37 ensure the requirements of cleanliness are being met as described within these specifications.
38 B. All contractors shall comply with other regulatory requirements as they apply to waste recycling, reuse, hauling,
39 and disposal requirements of any governmental authority having jurisdiction.
40 C. The Owner reserves the right to have work done by others in the event any contractor fails to perform cleaning
41 as described within these specifications. The cost of any Owner provided cleaning shall be charged to the
42 contractor through a deduct change order.
43

PART 2 - PRODUCTS

2.1. CLEANING MATERIALS AND EQUIPMENT

- 47 A. The Contractor shall provide all required personnel, equipment, and materials necessary to maintain the
48 required level of cleanliness as described in this specification.
49 B. Use only cleaning materials and equipment that are compatible with the surface being cleaned, as
50 recommended by the manufacturer, or as approved by the A/E.
51 C. Use only cleaning materials, equipment, and methods as recommended in the manufacturers care and use guide
52 of the material, finish or equipment being cleaned.
53

PART 3 - EXECUTION

3.1. SAFETY CLEANING

- 57 A. All Contractors shall be responsible for safety cleaning as required by OSHA and other regulatory requirements
58 as applicable.

- 1 B. Safety Cleaning shall include but not be limited to the following:
 - 2 1. All work areas, passageways, ramps, and stairs shall be kept free of debris, scrap materials, pallets, and
 - 3 other large items that would obstruct exiting routes. Small items such as tools, electrical cords, etc are
 - 4 picked up when not in use.
 - 5 2. Form and scrap lumber shall have nails/screws removed or bent over. Lumber shall be neatly stacked in
 - 6 an area designated by the GC.
 - 7 3. Spills of oil, grease, and other such liquids shall be cleaned immediately or sprinkled with sand/oil-dry
 - 8 first, then cleaned.
 - 9 4. Oily, flammable, or hazardous items shall be stored in appropriate covered containers and storage
 - 10 devices unless actively being used.
 - 11 5. Oily, or flammable rags, and other such waste shall only be disposed of in authorized covered containers.
 - 12 6. Disposal by burning shall not be allowed at any time.

13
14 **3.2. PROJECT SITE CLEANING**

- 15 A. This section applies to the general cleanliness of the project site as a whole for the duration of the execution of
- 16 this contract.
- 17 B. Exterior Project Site Areas
 - 18 1. The GC and other Contractors as appropriate shall ensure the following levels of cleanliness are applied
 - 19 to the exterior project site areas.
 - 20 a. The overall appearance of the project site is neat and orderly. Defined areas for material storage,
 - 21 material waste, job trailers, and the project area are clean and well maintained.
 - 22 b. The construction fence is maintained, erect with no gaps, and properly posted per all regulatory
 - 23 requirements.
 - 24 c. All erosion control measures are properly maintained, cleaned, and repaired as necessary.
 - 25 d. All loose materials (construction or waste) are properly tied or weighted down to resist blowing.
 - 26 e. All construction materials are properly covered with fully functional tarps or plastic wrap,
 - 27 protected from the weather, coverings are tied, strapped, or weighted down to resist blowing.
 - 28 f. Dust control is applied as necessary or as required by any regulatory requirement.
- 29 C. Interior Project Site Areas
 - 30 1. All Contractors shall ensure the following levels of cleanliness are applied to the interior project site
 - 31 areas.
 - 32 a. The overall appearance of the project site is neat and orderly. Defined areas for material storage,
 - 33 material waste, and project area are clean and well maintained.
 - 34 b. Stored materials are kept in original shipping containers whenever possible. Stored materials not
 - 35 in shipping containers are properly stored and protected according to other applicable
 - 36 specifications.
 - 37 c. All scraps and debris shall be properly disposed of as often as necessary to keep work areas,
 - 38 passageways, stairs, and ramps free of debris and clear for emergency exiting.
 - 39 d. Boxes, pallets, and other such shipping containers, are broken down, stored in a consolidated area
 - 40 or, disposed of as often as is necessary.
 - 41 e. Hand tools, supplies, materials, electrical cords not being used are picked up and stored in gang
 - 42 boxes, not left as walking hazards in work areas, passageways, etc.
- 43 D. Job Trailer
 - 44 1. The interior of the job trailer shall be kept clean and available as a work space at all times. The GC shall
 - 45 ensure that the following is provided for within the job trailer:
 - 46 a. Meeting space including tables and chairs.
 - 47 b. Sufficient space for all contractors to access the official construction documents, provide updates,
 - 48 etc.

49
50 **3.3. PROGRESS CLEANING**

- 51 A. This sub-section shall apply to all Progress Cleaning prior to the installation of finishes, fixtures, and trim (IE
- 52 rough-in).
 - 53 1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other
 - 54 material capable of being removed by use of reasonable effort using a good quality janitor broom and
 - 55 shop-vac.
 - 56 2. Daily cleanings shall be conducted by all contractors at the end of the work day as follows:
 - 57 a. Debris in excavated areas shall be removed prior to backfill and compaction.
 - 58 b. Debris in wall cavities, chase spaces, etc shall be removed prior to enclosing the spaces.

- 1 c. Large items shall be properly stored, returned to designated areas, or disposed of as necessary.
2 d. Loose materials shall be properly secured.
3 e. Flammable or hazardous materials are properly stored or disposed of.
4 3. Weekly cleaning shall be conducted by all contractors as designated by the GC. Weekly cleanings shall
5 include all the above for a daily cleaning and other necessary cleaning as designated by the GC.
6 B. This sub-section shall apply to Progress Cleaning in preparation for the installation of finishes, fixtures, and trim.
7 a. Surfaces receiving finishes shall be thoroughly cleaned prior to contractors applying finish
8 materials. The GC shall be responsible for inspecting the area and surfaces being cleaned for
9 finish prior to the sub-contractor applying the finish. This shall include but not be limited to the
10 following:
11 i. Wall surfaces shall be wiped clean of dirt and oily residues, vacuumed free of dust, and
12 shall be free of surface imperfections prior to painting or installing wall coverings.
13 ii. Metal surfaces shall be wiped clean of dirt and oily residues, and be free of surface
14 imperfections prior to painting.
15 iii. Flooring shall be broom swept of large and loose items then vacuumed clean of dust and
16 small particles, and damp mopped clean and dried prior to installing any flooring finish.
17 Additional cleaning may be required depending on the preparation requirements
18 recommended by the flooring material manufacturer.
19 C. This sub-section shall apply to Progress Cleaning after the installation of finishes, fixtures, and trim.
20 1. For the purposes of this section "clean" shall be defined as a level of cleanliness free of dust and other
21 material capable of damaging or visually disfiguring finished work, finishes, fixtures, and trim.
22 2. Progress Cleaning at this point in the contract shall be conducted immediately as follows:
23 a. Dust, dirt, etc shall be swept and vacuumed off of finish flooring and trim.
24 b. Liquid spills shall be cleaned up according to the spill type. This shall include drips and spills
25 caused by paint, stain, sealants, and other such items.
26 3. The Contractor(s) at no additional cost to the Owner shall be responsible for replacing any finished work,
27 finishes, fixtures, and trim damaged or disfigured because of inadequate or improper cleaning.
28

29 3.4. FINAL CLEANING

- 30 A. As noted in Specification 01 29 76 Progress Payment Procedures, Progress Payment Milestone Schedule, Final
31 Cleaning shall not be conducted prior to requesting the 90% contract total progress payment and all of the
32 following shall be complete:
33 1. All final regulatory inspections including but not limited to Building Inspection Department and Madison
34 Fire Department inspections have been successfully completed.
35 2. All Quality Management Observation (QMO) reports have been closed out.
36 3. All Demonstration and Training has been completed.
37 4. All Attic Stock has been consolidated and located to its designated area
38 5. All protection for installed construction shall be removed prior to final cleaning by the contractor
39 responsible for providing the protections. This shall include the removal of any adhesive residues left
40 behind from tapes. Contractors shall only use manufacturer authorized cleaning materials for removing
41 adhesives, etc.
42 B. For the purposes of this section "clean" shall be defined as a level of cleanliness generally provided by skilled
43 cleaners using commercial quality building maintenance equipment and materials.
44 C. The GC shall be responsible for ensuring that all requirements under this section are being met.
45 D. General Requirements
46 1. Employ experienced personnel or professional cleaners for final cleaning as necessary for the areas or
47 equipment being cleaned.
48 2. Cleaning equipment used shall be commercial grade equipment commonly used by professional cleaners.
49 3. Cleaning equipment and materials shall be cleaned, rinsed, or replaced to ensure a uniform level of
50 cleanliness is being maintained during the final cleaning. This shall include but not be limited to the
51 following:
52 a. Vacuum cleaner bags and/or filters are changed and/or cleaned as often as necessary.
53 b. Dust & wipe down rags are washed, rinsed, or replaced before starting each room.
54 c. Mopping equipment
55 i. Mop water for washing shall have cleaning solution added to the amount and temperature
56 per manufacturer's recommendations. Mop washing water shall be replaced often to
57 maintain the levels of the cleaning solution and temperature required.
58 ii. Mop water for rinsing shall remain clean, clear, and be replaced as often as necessary.

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- iii. Mop heads shall be rinsed often and replaced as necessary.
 - iv. Mop heads and buckets shall be thoroughly rinsed with each change of water.
 - v. Only new mop heads shall be used for rinsing.
- E. Refer to all other specifications in this contract for specific requirements regarding final cleaning of finishes, fixtures, equipment, etc.
- F. Exterior Cleaning shall include but not be limited to the following:
1. All exterior glazing surfaces have been professionally cleaned and are free of dust and streaking.
 2. Metal roofs, siding, and other surfaces shall be clean of dirt and free of splashed or excess materials such as sealants, mortar, paint, etc.
 3. All exterior furnishings shall be clean, waste receptacles shall be empty.
 4. Paved areas shall be clean, free of dirt, oily stains and other such blemishes
 5. Exterior lights and diffusers are clean and free of dust.
- G. Interior Cleaning shall include but not be limited to the following:
1. Remove all labels, stickers, tags, and other such items which are not required by code as permanent labels.
 2. All interior glazing surfaces, including mirrors, have been professionally cleaned and are free of dust and streaking.
 3. All interior surfaces have been cleaned of excess materials such as paint, sealants, etc and have been wiped free of dust.
 4. Interior metals, fixtures, and trim have been cleaned free of dust and oily residues
 5. Carpet flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains removed per manufacturers use and care instructions.
 6. Resilient flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains removed, mopped and buffed per manufacturers use and care instructions.
 7. Interior non-occupied concrete floors shall be broom cleaned, vacuumed free of dust, excess glues and other stains removed per manufacturers use and care instructions.
 8. Light fixtures, lamps, diffusers and other such items have been dusted and cleaned as necessary.

3.5. CALL BACK WORK

- A. The GC shall be responsible for ensuring that any contractor returning to the project site for completion or correction work has re-cleaned and restored the area to the levels described in section 3.4 above upon completion of the work. This shall include but not be limited to the following:
1. The immediate area(s) where work was completed.
 2. Adjacent areas where dust or debris may have traveled.
 3. Other areas occupied during the completion of the call back work.
 4. Path of entrance/exit, to/from the area(s) of work.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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PART 1 – GENERAL

1.1. SUMMARY

- 24 A. This specification includes administrative and procedural requirements for the recycling, re-use, salvaging, and
25 disposal of non-hazardous construction and demolition waste.
26 B. The General Contractor (GC) shall be fully responsible for complying with all applicable ordinances and other
27 such regulatory requirements during the execution of this contract.
28

1.2. RELATED SPECIFICAITONS

- 30 A. 01 29 76 Progress Payment Procedures
31 B. 01 31 23 Project Management Web site
32 C. 01 32 19 Submittals Schedule
33 D. 01 33 23 Submittals
34 E. 01 77 00 Closeout Procedures
35 F. Other Divisions and Specifications that may address the proper disposal of construction or demolition waste as it
36 pertains to work being conducted under that particular specification.
37

1.3. CITY ORDINANCES

- 39 A. There are two (2) Madison General Ordinances (MGO) that the City of Madison has regarding construction and
40 demolition waste.
41 1. MGO 10.185, Recycling and Reuse of Construction and Demolition Debris, describes the requirements
42 associated with this ordinance including definitions, documentation requirements, and penalties.
43 2. MGO 28.185, Approval of Demolition (Razing, Wrecking) and Removal, describes the requirements
44 associated with applying for and receiving a demolition permit.
45 B. All City of Madison, Board of Public Works, contracts being conducted by City Engineering, Facility Management,
46 for construction, remodeling, or demolition shall comply with the above ordinances regardless of project type or
47 size.
48

1.4. DEFINITIONS

- 50 A. Clean: Untreated and unpainted material, free of contamination caused by oils, solvents, caulks, and other
51 chemicals.
52 B. Construction and Demolition Debris: Materials resulting from the construction, remodeling, repair, and
53 demolition of utilities, structures, buildings, and roads.
54 C. Disposal: Off-site removal of construction and demolition debris and the subsequent sale, recycling, reuse, or
55 deposit in authorized landfill or incinerator.
56 D. Hazardous: Exhibiting the characteristics of hazardous substance, i.e. ignitability, corrosiveness, toxicity, or
57 reactivity and including but not limited to asbestos containing materials, lead, mercury and PCBs.
58 E. Non-hazardous: Exhibiting none of the characteristics of a hazardous substance.

- 1 F. Nontoxic: Not immediately poisonous to humans or poisonous after a long period of exposure.
- 2 G. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured
- 3 into a new product.
- 4 H. Recycle: Any process by which construction or demolition debris is diverted from final disposal as solid waste at
- 5 a permitted landfill and instead is collected, separated, and/or processed into raw materials for new, reused, or
- 6 reconstituted products; or for the recovery of materials for energy production processes.
- 7 I. Recycler: Any recycling facility, transfer station, or other waste handling facility which accepts construction and
- 8 demolition debris for recycling, or for other transferring to a recycling facility.
- 9 J. Recycling: The process of sorting, cleaning, treating, or reconstituting solid waste and other discarded materials
- 10 for the purpose of preparing the material to be recyclable. Recycling does not include burning, incinerating or
- 11 thermally destroying waste.
- 12 K. Return: To give back reusable items or unused products to vendors for credit.
- 13 L. Reuse: Shall mean any of the following:
- 14 1. The on-site use of reprocessed construction and demolitions debris.
- 15 2. The off-site redistribution of a material, for use in the same manner or similar manner at another
- 16 location.
- 17 3. The use of non-toxic, clean wood as an alternative fuel source.
- 18 M. Salvage: To remove a waste material from the project site for resale or reuse by the Owner or others.
- 19 N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- 20 O. Trash: Any product or material unable to be re-used, returned, recycled, or salvaged.
- 21 P. Waste: Extra materials or products that have reached the end of its useful life or its intended use. Waste
- 22 includes salvageable, returnable, recyclable and re-useable construction and demolition materials, and trash.
- 23

24 1.5. PERFORMANCE REQUIREMENTS

- 25 A. The GC shall develop a Waste Management Plan that results in end-of-project rates for salvage/recycling/reuse
- 26 of 95 percent (minimum) by weight of the total waste generated by the Work. Percentages may be adjusted on
- 27 a project by project basis depending on selected LEED goals associated with the project.
- 28 B. The GC shall salvage or recycle 100 percent of all uncontaminated packaging materials including but not limited
- 29 to the following:
- 30 1. Paper
- 31 2. Cardboard
- 32 3. Beverage containers
- 33 4. Boxes
- 34 5. Plastic Sheet and film
- 35 6. Polystyrene packaging
- 36 7. Wood crates and pallets
- 37 8. Plastic pails and buckets
- 38 C. Promote a resourceful use of supplies and materials through proper planning and handling. Generate the least
- 39 amount of waste possible by minimizing errors, poor planning, breakage, mishandling, contamination or other
- 40 similar factors.
- 41 D. Use all reasonable means to divert construction waste from landfills and incinerators through recycling, reuse, or
- 42 salvage as appropriate.
- 43

44 1.6. SUBMITTALS AND DELIVERABLES

- 45 A. The GC shall provide his/her completed Waste Management Plan to the Project Management Web Site as a
- 46 submittal for review by the Project Architect and City Project Manager.
- 47 1. See item 1.8 below for Waste Management Plan submittal requirements.
- 48 2. The Waste Management Plan shall be completed, submitted, and approved as a pre-requisite for
- 49 Progress Payment number 1.
- 50 3. Copies of all documentation required by this specification shall be submitted to the appropriate Project
- 51 Management Web Site Library. Documentation shall be reviewed by the City Project Manager during all
- 52 Progress Payment reviews for compliance and accuracy.
- 53 B. The Waste Management Coordinator shall provide copies of items 1 through 5 below to the appropriate Project
- 54 Management Web Site Library and shall update the Waste Management Summary Log to reflect the records
- 55 being submitted.
- 56 1. Records of Donations: Indicate receipt and acceptance of itemized salvageable waste donated to
- 57 individuals or organizations. Indicate if the organization is tax exempt.

- 1 2. Records of Sales: Indicate receipt and acceptance of itemized salvageable waste sold to individuals or
- 2 organizations. Indicate if the organization is tax exempt.
- 3 3. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by
- 4 recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts and
- 5 invoices.
- 6 4. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and
- 7 incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts and invoices.
- 8 5. Statement of Refrigerant Recovery: The Refrigerant Recovery Technician responsible for recovering
- 9 refrigerant shall provide the GC with a statement indicating all of the following:
- 10 a. All recovery was performed according to EPA Regulations.
- 11 b. All refrigerant present was recovered; indicate the total quantity recovered by unit.
- 12 c. Date of Recovery.
- 13 d. Name, address, company name, and phone number of technician performing the recovery.
- 14 e. Technician shall sign and date the statement.
- 15 C. LEED Submittal: The GC shall provide the following information using the appropriate LEED letter template upon
- 16 project completion: indicating that the requirements of the credit have been met. *NOTE: This requirement shall*
- 17 *only apply to projects having a LEED certification goal.*
- 18 1. Total waste material generated.
- 19 2. Total waste material diverted by diversion method; recycling, salvage, re-use, etc.
- 20 3. Statement that the credit requirements have been met.
- 21 4. GC shall sign the letter.
- 22

23 **1.7. QUALITY ASSURANCE**

- 24 A. Waste Management Coordinator: The GC shall be responsible for designating a Waste Management
- 25 Coordinator. Coordinator may be the GC Supervisor, GC Project Manager or other member of the GC staff
- 26 having knowledge of proper waste management procedures and all applicable regulations.
- 27 B. Regulatory Requirements: comply with all hauling and disposal regulations of authorities having jurisdiction.
- 28 C. The Waste Management Coordinator shall comply with Specification 01 31 19 Project Meetings, Section 3.7.B.1
- 29 and conduct a Waste Management Conference at the job site. This conference shall be repeated as necessary as
- 30 additional trades are added to the Work. The conference shall include but not be limited to the following:
- 31 1. Identify the Waste Management Coordinator; provide trade contractors with name, phone, and email
- 32 information.
- 33 2. Review and discuss the Waste Management Plan and the roles of the Coordinator.
- 34 3. Review the requirements for documenting and reporting procedures of each type of waste and its
- 35 disposition.
- 36 4. Review procedures for material separation; indicate availability and locations of containers and bins.
- 37 5. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
- 38 6. Review waste management procedures specific to each trade.
- 39 D. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- 40

41 **1.8. WASTE MANAGEMENT PLAN**

- 42 A. Develop a plan consisting of waste identification, a waste reduction work plan, and cost/revenue analysis.
- 43 Indicate quantities by weight or volume. Use the same units of measure throughout the waste management
- 44 plan.
- 45 1. Waste Identification: Indicate anticipated types and quantities of site clearing, demolition waste, and
- 46 construction waste that will be generated during the execution of this contract. Include assumptions for
- 47 the estimates.
- 48 2. Waste Reduction Work Plan: The work plan shall consist of but not be limited to all of the following:
- 49 a. Identify methods for reducing construction waste. Re-using, framing and forming materials, re-
- 50 planning material cuts to minimize waste, etc.
- 51 b. Identify what types of materials will be recycled. Provide lists of local companies that receive
- 52 and/or process the materials. Include names, addresses, and phone numbers.
- 53 c. Identify what types of materials will be disposed of and whether it will be disposed of in a landfill
- 54 facility or by incineration facility. Provide lists of local companies that receive and/or process the
- 55 materials. Include names, addresses, and phone numbers.
- 56 d. Identify methods to be used on site for separating waste including all of the following:
- 57 i. Sizes of containers to be used.
- 58 ii. Labels to be used on the containers to identify the type of waste allowed in the container.

- 1 iii. Designated locations on the project site for waste material containers.
2 B. If project requires demolition incorporate the ordinance required (MGO 28.185) Recycling and Reuse Plan into
3 the Waste Management Plan.
4 C. Provide all of the following for the Waste Management Coordinator:
5 1. Name, employer, employer address, phone number, and email address of the designated coordinator.
6 a. The GC shall also provide this information with the required Project Directory Submittal at the
7 beginning of the project.
8 D. If at the option of the GC, he/she chooses to contract with a Waste Management Disposal Company that allows
9 comingled and unsorted waste materials, the GC shall include with his/her Waste Management Plan the
10 following:
11 1. Name, address, phone number, state permitting information, and other pertinent information about the
12 disposal company.
13 2. Documentation from the disposal company indicating company policies and procedures regarding
14 comingled and unsorted waste materials to include:
15 a. GC responsibilities on the project site.
16 b. Disposal company procedures for receiving, sorting, recycling, and disposing of comingled and
17 unsorted waste material.
18

19 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

20
21 **PART 3 - EXECUTION**

22
23 **3.1. PLAN IMPLEMENTATION**

- 24 A. Implement the approved waste management plan. Provide adequate containers, storage space, signage,
25 transportation and other items required to implement the plan during the execution of this contract.
26 B. The GC and Waste Management Coordinator shall be responsible for monitoring and reporting the status of the
27 Waste Management Plan and shall monitor the waste management practices on site as frequently as needed.
28 C. Train all workers, sub-contractors, and suppliers on proper waste management procedures as appropriate for
29 the work being conducted on the project site.
30 1. Distribute the waste management plan to everyone concerned within seven (7) days of submittal
31 approval.
32 2. Distribute the waste management plan to new workers, sub-contractors, and suppliers when they first
33 appear on the project site.
34 3. Conduct additional training as needed during the execution of the contract to keep a positive focus on
35 the waste management plan.
36 D. Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways,
37 and other adjacent and used facilities.
38 1. Designate and label specific areas on the project site necessary for separating materials to be salvaged,
39 recycled, reused, donated, and sold.
40 2. Comply with any specification or regulatory requirements pertaining to dust, dirt, environmental
41 protection, and noise control.
42

43 **3.2. HAZARDOUS AND TOXIC WASTE**

- 44 A. The Owner shall be responsible under separate contract for the removal of any asbestos related materials. All
45 other materials shall be removed by the GC.
46 B. All hazardous and toxic waste shall be separated, stored, and disposed of according to all applicable regulations.
47 C. All hazardous and toxic materials on site shall have a Material Safety and Data Sheet (MSDS) available that
48 indicates storage requirements, emergency information, and disposal requirements as necessary.
49

50 **3.3. GENERAL GUIDELINES FOR ALL WASTES**

- 51 A. Recycle all paper and beverage containers used by workers, sub-contractors, suppliers and visitors to the project
52 site.
53 B. All revenues, savings, rebates, tax credits, and other such incentives received from recycling, reusing, or
54 salvaging waste materials shall accrue to the GC unless specified otherwise in the contract documents.
55 C. Separate recyclable, reusable, and salvageable waste from other waste materials, trash, and debris except where
56 Waste Management Disposal Company allows comingled waste materials, see section 1.8.D above.
57 1. Separate by type in appropriate containers or designated areas according to the approved waste
58 management plan away from the construction area. Do not store within the drip lines of existing trees.

- 1 2. Inspect containers and bins frequently for contamination and inappropriately sorted materials. Remove
- 2 contaminated materials and resort as necessary.
- 3 3. Stockpile bulk materials such as sand, topsoil, stone, etc., on site away from the construction area and
- 4 without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water, and
- 5 cover to prevent windblown dust. Do not store within the drip lines of existing trees.
- 6 4. Whenever possible store items off the ground and/or protect them from the weather.
- 7

8 **3.4. GUIDELINES FOR RECYCLABLE, RE-USABLE, AND SALVAGEABLE WASTE**

- 9 A. The following guidelines is not a complete or all inclusive list and shall be adjusted as needed by the methods
- 10 and procedures identified in the Waste Management Plan.
- 11 B. Asphalt Paving: Break-up into transportable pieces or grind, transport to an authorized recycling facility.
- 12 C. Carpet and Pad: Separate carpet and pad scraps, containerize and transport to an authorized recycling facility.
- 13 D. Ceiling System Components: Suspended ceiling system components shall be sorted by material type as follows:
- 14 1. Broken, cut, or damaged tiles shall be containerized, transport to an authorized recycling facility.
- 15 2. Damaged, or cut tracks, trim and other metal grid system components shall be sorted with other metals
- 16 of similar types, palletize, transport to an authorized recycling facility.
- 17 E. Clean Fill: When allowed by Division 31 Specifications; concrete, masonry, stone, asphalt pavement, sand and
- 18 other such materials may be used as clean fill on this project site. The GC shall verify with the Project Architect,
- 19 Structural Engineer, or Civil Engineer as necessary prior to using any materials as clean fill. Materials shall be
- 20 processed, placed, and compacted as specified. If not being re-used on site, transport to an authorized recycling
- 21 facility.
- 22 F. Clean Wood Materials: Including but not limited framing cutoffs, wood sheathing or paneling materials,
- 23 structural or engineered wood products, and pallets or crates. Clean Wood shall be free of paints, stains, oils,
- 24 preservatives and other such contaminants.
- 25 1. Useable pieces shall be sorted by type and dimension, bundled and transported off site by the GC or
- 26 returned to the supplier.
- 27 2. Non-useable pieces shall be palletized or containerized, transport to an authorized recycling facility.
- 28 3. Clean, uncontaminated sawdust and wood shavings shall be bagged, transport to an authorized recycling
- 29 facility.
- 30 G. Concrete: Break-up into transportable pieces, remove all reinforcing and other metals, transport to an
- 31 authorized recycling facility.
- 32 H. Glass Products: Shall be sorted by types, do not include light fixture lamps and bulbs. Products broken in
- 33 shipment shall be returned to the supplier. Broken or cracked items still in frames shall be taped to prevent
- 34 further breakage and injury to workers. Transport to an authorized recycling facility.
- 35 I. Gypsum Board: Stack large clean pieces on wooden pallets or container, store in a dry location, transport to an
- 36 authorized recycling facility.
- 37 J. Light Fixture Lamps and Bulbs: Fluorescent tubes shall be containerized, transport to an authorized recycling
- 38 facility.
- 39 K. Masonry and CMU: Remove all metal reinforcing, anchors, and ties, clean undamaged pieces and neatly stack on
- 40 pallets, transport damaged pieces to an authorized recycling facility.
- 41 L. Metals: Sort metals by type as follows, this does not include piping:
- 42 1. Architectural metals including but not limited to siding, soffit, and roofing panels shall be sorted by
- 43 material, palletize or bundle as needed and transport to an authorized recycling facility.
- 44 2. Structural steel, sort by size and type; palletize and transport to an authorized recycling facility.
- 45 3. Miscellaneous metals such as aluminum, brass, bronze, etc shall be sorted by type, containerized or
- 46 palletized as necessary, transport to an authorized recycling facility.
- 47 M. Packaging and shipping materials
- 48 1. Cardboard boxes and containers: Breakdown all cardboard boxes and containers into flat sheets. Bundle
- 49 and store in a dry location until transported for recycling.
- 50 2. Pallets:
- 51 a. Whenever possible require deliveries using pallets to remove them from the project site.
- 52 b. Neatly stack pallets in preparation for reusing them or providing them to other companies for
- 53 salvage or re-use.
- 54 c. Break down pallets into component wood pieces that comply with the requirements for recycling
- 55 clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
- 56 3. Crates: Break down crates into component wood pieces that comply with the requirements for recycling
- 57 clean wood materials. Neatly stack or palletize pieces in preparation for transportation.
- 58 4. Polystyrene Packaging: Separate and bag materials.

- 1 N. Piping and conduit: Reduce all piping and conduit to straight lengths, sort and store by size, material and type.
2 Remove supports, hangers, valves, boxes, sprinkler heads, and other such components, sort and store by size,
3 material and type. Transport to authorized recycling facilities according to material types.
4 O. Roofing: Roofing materials shall be sorted and containerized by type, transport to authorized recycling facilities
5 according to material types.
6 P. Site-Clearing Waste: Sort all site waste by type.
7 1. Only stockpile soils types and quantities required for re-use on the project site. All remaining quantities
8 shall be transported off site to an authorized facility that receives such materials.
9 2. Brush, branches, and trees with no marketable re-use shall be transported to facilities for chipping into
10 mulch.
11 3. Trees with a marketable re-use shall be salvaged and transported to facilities that specialize in processing
12 trees for future use as wood products.
13

14 **3.5. GUIDELINES FOR DISPOSAL OF WASTES**

- 15 A. The following guidelines shall be adjusted as needed by the methods and procedures identified in the Waste
16 Management Plan.
17 B. Any waste that is contaminated, organic, or cannot be recycled, re-used, or salvaged shall be legally disposed of
18 in an authorized landfill or incinerator. Disposal methods shall follow all applicable regulatory requirements.
19 C. No waste material of any kind, except those types designated as clean fill in section 3.4 above, shall be allowed
20 to be buried on the project site at any time.
21 D. No burning of any kind of waste material shall be permitted on this project site at any time.
22 E. Paint and Stain: Paints, stains, and their containers shall be disposed of as follows:
23 1. Whenever possible containers should be thoroughly cleaned immediately after emptying and sorted with
24 as appropriate (metal or plastic) for recycling
25 2. Empty containers, regardless of type or base material, may be disposed of with lids off with general
26 garbage.
27 3. Latex paint may be placed with general garbage if properly solidified as follows:
28 a. Small amounts (an inch or less in can): Remove lids and allow paint to dry out in the can and
29 harden. Protect cans from rain and freezing.
30 b. Large amounts (more than one inch): Mix paint with equal amounts of cat litter, stir and allow to
31 completely dry. Alternate method: mix with commercial paint hardener.
32 4. Oil-based or combustible paints and stains, regardless of liquid or solid, shall be transported to an
33 approved facility that takes such items such as Dane County Clean Sweep Sites.
34 F. Treated Wood Materials: Treated wood materials including but not limited to wood that has been painted,
35 stained, or chemically treated shall not be recycled or incinerated.
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END OF SECTION

SECTION 01 76 00
PROTECTING INSTALLED CONSTRUCTION

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PART 1 – GENERAL

1.1. SUMMARY

- 25 A. The purpose of this specification is to provide clear responsibilities, guide lines, and requirements related to
26 providing protection to already installed construction.
27 B. Already installed construction shall include but not be limited to the following:
28 1. Any existing site feature such as pavement, curbs, drainage features, utilities, landscaping features (trees,
29 shrubbery, plantings, flagpoles, etc) and other such exterior items not associated with the building
30 whether on or adjacent to the project site.
31 2. Any existing structure on or adjacent to the project site.
32 3. Any existing interior work that may be adjacent to the new work including all paths of ingress/egress to
33 areas associated with accessing the Work.
34 4. Any existing feature of any kind within the public right-of-way that may be on the project site property,
35 adjacent to the project site or across the street from the project site.
36 C. All contractors shall be familiar with the specifications of their Division of Work for specific requirements on
37 protection of the Work.
38 D. The requirements noted within this specification do not relieve any contractor of the responsibility for
39 compliance with any code, statute, ordinance, or other such regulatory requirement having jurisdictional
40 authority over these contract documents.

1.2. QUALITY ASSURANCE

- 43 A. It shall be the responsibility of every contractor and worker assigned to the project to be diligent in protecting all
44 existing work, and newly installed construction.
45 B. It shall be the General Contractors' (GC) responsibility under the contract to provide all reasonable protection
46 methods, materials, or precautionary measures required to protect new or existing construction as described in
47 within this specification to the project as a whole.
48 1. The GC shall be responsible to ensure any damaged new or existing construction is repaired or replaced
49 at no additional cost to the Contract.
50 2. The GC at his/her discretion may direct other contractors to provide and maintain protection of
51 completed work associated with their Division of Work. I.E.: The carpet installer may be required by the
52 GC to provide carpet protection along traveled paths, ingress/egress, etc after installation.
53 C. It shall be the responsibility of the GC to ensure that all materials being used to protect installed construction are
54 compatible with, and/or adjacent to, the materials being protected. This shall include but not be limited to the
55 material used as covering, tapes used to fasten protective materials, etc.

1
2 **1.3. RELATED SPECIFICATIONS**

- 3 A. Parts of this specification will reference articles within "The City of Madison Standard Specifications for Public
4 Works Construction".
5 1. Use the following link to access the Standard Specifications web page:
6 <http://www.cityofmadison.com/business/pw/specs.cfm>
7 a. Click on the "Part" chapter identified in the specification text. For example if the specification
8 says "Refer to City of Madison Standard Specification 210.2" click the link for Part II, the Part II
9 PDF will open.
10 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
11 to the referenced text.
12 c. City Standard Detail Drawings (SDD) may be located from the index in Part VIII.
13 B. Section 01 60 00 Product Requirements
14 C. Section 01 74 13 Progress Cleaning
15

16 **PART 2 - PRODUCTS**

17
18 **2.1. FENCING MATERIALS AND BARRICADES**

- 19 A. Except where noted in other areas of the construction documents, the responsible contractor shall provide a six
20 foot galvanized chain link fence including full height mesh screen at the project lines as shown on the Civil
21 Drawings. For temporary barricade situations, the responsible contractor may provide one of the following that
22 sufficiently provide a sturdy physical barrier and/or visual barrier as necessary for the intended application.
23 1. Standard orange construction barrels each with a standard rubber base ring and reflective tape
24 a. Provide flashing amber lights as needed to increase night time visibility
25 2. Steel "T" style fence posts
26 3. 4'0" high standard orange construction fence
27 4. Traffic barricades
28 5. Jersey barriers
29 6. Other types of fencing or barricades typically used in the construction industry
30 B. The contractor responsible for providing the fencing materials and barricades shall also be responsible for
31 maintaining them. This shall include but not limited to fixing damaged fencing, standing up barrels that have
32 been knocked over, realigning barrels, and ensuring flashing lights are fully operational at all times.
33 C. The following fencing and barricade designations, and their use descriptions shall be used throughout this
34 specification to provide uniformity in describing protection requirements.
35 1. Type A, Jersey Barriers, to be used as permanent blocking devices to deny access to alternate project site
36 entrances or exits.
37 2. Type B, Traffic Barricades, to be used as temporary blocking devices to deny access to alternate project
38 site entrances or exits.
39 3. Type C, Construction Barrels without construction fencing shall be used for lane closures, temporary
40 blocking devices to deny access and the protection of single locations (I.E. identify the location of an
41 access structure) that do not require fencing.
42 4. Type D, Construction Barrels with construction fencing where it becomes necessary to surround an object
43 with a complete visual barricade and it is impractical or unacceptable to install fence posts. The surround
44 shall be constructed in such a manner as to provide a buffer zone around and access to the item being
45 protected.
46 5. Type E, Steel "T" Fence Posts shall be used at the project lines, as indicated on the Civil Drawings, with six
47 foot galvanized chain link fencing to surround an object with a complete visual barricade and it is
48 practical to install fence posts. The surround shall be constructed in such a manner as to provide a buffer
49 zone around and access to the item being protected. All posts shall be driven installed. Surface mounted
50 posts to only be used for temporary barricades.
51 6. Type X, Other fencing or barricade types that may be designated and detailed within the construction
52 documents shall use additional alpha numeric designations.
53

54 **2.2. EROSION CONTROL PROTECTION**

- 55 A. Refer to City of Madison Standard Specification 210.2 for authorized materials associated with erosion control
56 materials.
57

1 **2.3. INTERIOR FINISH PROTECTION MATERIALS**

- 2 A. Except where noted in other areas of the construction documents or this specification the responsible
3 contractor:
4 1. Shall not provide the cheapest or least effective method as an effort to meet any protection requirement.
5 2. Shall provide materials of sufficient quality, and durability to provide adequate protection based on the
6 seasonal conditions and the anticipated duration at the time the protection will be needed.
7 3. Shall provide sufficient quantity of protection material to protect the construction as needed.
8 B. Prior to installing protective measures the responsible contractor shall propose to the GC, Project Architect (PA)
9 and City Project Manager (CPM) the proposed plan for protection, materials to be used and samples as
10 necessary.
11 1. The PA and CPM reserve the right to disapprove any proposed method and/or material and/or make
12 alternate proposals.
13

14 **PART 3 - EXECUTION**

15
16 **3.1. GENERAL EXECUTION REQUIREMENTS**

- 17 A. The GC shall be responsible for ensuring all of the following procedures and requirements are implemented as
18 needed for the duration of the Work performed under this contract.
19 B. The GC shall also be responsible for the following:
20 1. Reporting any incident of damage to existing property, right-of-way, or utility to the CPM immediately
21 upon rendering the incident safe, and notifying emergency response teams, and emergency utility crews
22 as needed.
23 2. Conduct a site walk through prior to leaving at the end of each day to assess:
24 a. Protection measures are properly in place, provide correction actions as necessary.
25 b. Note damage to existing completed work and schedule repair/replacement as needed.
26 3. Ensure all contractors and workers are being diligent in protecting existing work, and newly installed
27 construction.
28

29 **3.2. PROTECT ADJACENT PROPERTIES**

- 30 A. Whenever possible through the design process the City of Madison shall have previously provided notice to
31 adjacent property owners that work will be occurring on or near their property. The City of Madison shall also
32 have obtained any permanent or temporary easements that may be necessary to complete any Work on
33 adjacent properties.
34 B. It shall be the responsibility of the GC to do the following for all Work under this contract being performed on or
35 adjacent to the property line:
36 1. Contact the adjacent property owner and provide him/her with information on the work to be done,
37 equipment to be used, and estimated duration of the work. Information to be updated and
38 communicated to property owner(s) as construction progresses and site conditions change.
39 a. If any adjacent property is a rented or leased space the GC shall also make contact and provide
40 the same information to the tenants.
41 b. Determine from the owner and/or tenants if there are any concerns for children, pets, special
42 plantings, or other concerns.
43 2. Discuss the following with all contractors performing work on or near the property line.
44 a. Work to be completed and timeline.
45 b. Concerns of adjacent property owners/tenants from item 1 above.
46 c. Which protective measures will be necessary to protect adjacent properties and address the
47 concerns of adjacent property owners/tenants.
48 3. Ensure all protective measures are placed and maintained during the execution of Work on or adjacent to
49 the property line. Interact with the adjacent property owners/tenants as needed.
50 C. Any contractor doing work on or adjacent to the property line shall install and maintain any protective measure
51 identified in the contract documents, this specification, or as directed by the GC.
52 D. The GC shall be responsible for restoring any damage to structure and property located on or adjacent to the
53 property line.
54 1. Restoration shall include but not be limited to repair or replacement using like materials and finishes to
55 its original condition or better.
56 2. Restoration of landscaping materials shall include watering of any seed, sod, or other planting of any kind
57 for a reasonable period of time to encourage germination and root development.
58 E. The GC shall keep the CPM informed directly to any issues pertaining to adjacent property owners and tenants.

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3.3. PROTECT LANDSCAPING FEATURES

- A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. Whenever possible do not install new landscape features until exterior building construction has been completed, equipment such as scaffolding and lifts are no longer needed and have been removed, and heavy equipment operation is no longer required.
 - 2. Whenever possible remove and temporarily store all existing landscape features such as benches, waste receptacles, signage, and other such features that will be within the area of Work that can be removed.
 - 3. Landscape features that cannot be removed such as flag poles, light poles, light bollards, etc. shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
 - 4. Planting beds shall be protected using Type E fencing around the exposed perimeter of the planting bed as needed.
 - 5. The City of Madison Standard Specification 107.13 shall apply to all tree protection in and around the project site at all times.

3.4. PROTECT UTILITIES

- A. The contractor shall be responsible for notifying all utilities to determine emergency response procedures and protection requirements prior to installing any construction protection.
 - 1. This includes requesting utility marking through Diggers Hotline.
 - a. Call 811 or 1-800-242-8511 to request a public utility locate
 - b. For emergency locate call (262) 432-7910 or (877) 500-9592
 - 2. Contact the Owner and CPM for any available private utility information on the property that may be available prior to calling a private utility locating company.
- B. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. Hydrants, lamp posts, electrical transformers, and other utility pedestals shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil. Fence posts shall be located so as to not be directly over the utility main.
 - 2. Storm sewer structures in pavement shall have proper inlet protection according to City of Madison Standard Specification 210.1(g) and Type C Construction Barrels when necessary.
 - 3. Storm sewer structures in turf and other landscaped areas shall have proper inlet protection according to City of Madison Standard Specification 210.1(g) and Type E fencing for areas on soil.
 - 4. Stormwater management features such as greenways, retention/detention ponds, bio-filtration ponds and other such features shall be properly protected according to the appropriate erosion control measure specified on the Erosion Control Plan. See multiple sections of City of Madison Standard Specification 210.1
 - a. For the protection of hard to see items such as structures, castings, inlets, etc. in grassy areas provide Type E fencing for areas on soil.
 - c. For the protection of storm water management features having special soils and plants such as bio-filtration ponds provide Type E fencing for areas on soil.
 - 5. Other structures and covers including but not limited to cleanouts, wiring hand holes, valve boxes, access structures, grease trap structures, etc shall be protected as follows:
 - a. Provide Type E fencing for areas on soil.
 - b. When paving operations are complete provide a construction barrel or cone near structures as necessary depending on required heavy construction traffic.

3.5. PROTECT PUBLIC RIGHT OF WAY

- A. Except where specifically stated in other areas of the construction documents the following minimal protection requirements shall apply under this section.
 - 1. All public right-of-way (area from behind the sidewalk to the centerline of the street) shall remain open and accessible except during periods of active work. At such times the public right of way shall be properly closed and signed as referenced in City of Madison Standard Specification 107.9.
 - 2. Bus stops and bus stop structures shall remain accessible at all times.
 - 3. Traffic signage and traffic signals, traffic control boxes shall be protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
 - a. Protection at traffic signage/signals shall not obstruct the viewing of the sign/signal for its intended purpose at any time.

- 1 B. When additional protection for traffic control is required, the use of barricades, guardrails, lane closures and
2 other such procedures will be detailed within the construction documents.
3 C. When additional protection for overhead sidewalk cover is required the contract documents shall indicate the
4 specific location and structural requirements of the protective structure.
5

6 **3.6. PROTECT STORED MATERIALS**

- 7 A. All contractors shall refer to Specification 01 60 00 Product Requirements for all storage and protection
8 requirements of building materials and products delivered to the site.
9

10 **3.7. PROTECT WORK - EXTERIOR**

- 11 A. Provide all temporary services that may be required to protect the installed material from heat, cold, humidity,
12 etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
13 B. Open trenches, pits, and other such excavations shall be properly covered, lined, or shored as needed during
14 periods of inclement weather to prevent the caving of soils onto existing work in progress. Refer to the
15 appropriate specifications and/or regulatory requirements governing this type of work as necessary.
16 C. Provide adequate protection at all openings with heavy duty tarps, plastic sheathing, or wood framing and
17 sheathing as needed to protect interior work in progress from inclement weather as needed.
18 D. Protect exterior finishes of all kinds with heavy duty tarps or plastic sheathing as needed while landscaping is
19 being installed through full germination of seeded areas or installation of filter fabric and mulches to keep dust,
20 dirt, and mud off of finished exterior surfaces.
21 E. Designate specific curb mounting points and provide wood blocking where small vehicles, skid loaders and other
22 such equipment may need access to areas being landscaped.
23 F. Provide plywood turning pads for skid loaders to turn on to prevent tire marking on new pavement.
24 G. Do not permit the parking of vehicles with any kind of fluid leaks to park on new pavement.
25 H. The contractor shall be responsible for cleaning, repairing, or replacing any completed work or work in progress
26 under this specification as deemed necessary by the CPM without additional cost to the contract.
27

28 **3.8. PROTECT WORK - INTERIOR**

- 29 A. The GC shall do all of the following:
30 1. Provide all temporary services that may be required to protect the installed material from heat, cold,
31 humidity, etc, while materials such as concrete, mortar, sealants, paints, etc, are drying and/or curing.
32 2. Provide adequate visual and/or physical protection as needed to protect newly completed interior work
33 such as paint, flooring material, sealants, grouts, etc that may be drying and/or curing.
34 3. Provide adequate space and materials for cleaning boots, tool boxes, supplies, and other items coming
35 into the project site once finish work has begun.
36 4. Clean dirtied areas and repair/replace damaged areas immediately.
37 B. The contractors responsible for interior work shall be responsible for protecting their work and finishes from dirt,
38 mud, snow, spills, splatters, and physical damage after installation as follows:
39 1. Protect vinyl composite, rubber composite, painted/stained concrete, and tiled flooring as follows:
40 a. Define foot traffic areas and protect with Ramboard Temporary Floor Protection products as a
41 minimum basis of design or other protection product(s) compatible with installed flooring product
42 if Ramboard is not compatible. Products to be used shall be new.
43 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
44 not allow any debris or other material between the installed flooring and the protection
45 material.
46 ii. Repair tears immediately, replace worn areas with like material as necessary.
47 2. Protect carpeted areas as follows:
48 a. Define foot traffic areas and protect with a minimum of 6mil, clear, polyethylene sheeting 3 feet
49 wide. Products to be used shall be new.
50 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
51 not allow any debris or other material between the installed flooring and the protection
52 material.
53 ii. Repair tears immediately, replace worn areas with like materials as necessary.
54 3. Protect all finished walls in high traffic areas with Ramboard Temporary Wall protection products or
55 approved equal.
56 i. Tape all edges, seams, etc with a good quality tape that does not leave sticky residue. Do
57 not allow any debris or other material between the installed flooring and the protection
58 material.

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- ii. Repair tears immediately, replace worn areas with like materials as necessary.
 - 3. Protect counter tops, cabinets, and other finished surfaces with large sheets of thick cardboard or Ramboard products. Do not allow toolboxes, finish materials, parts and other such items to be placed on finished materials.
 - C. All protection shall stay in place until the CPM, PA, and GC mutually deem the project is ready for Final Cleaning. The contractors responsible for protecting the work shall be responsible for removing the protection and removing any adhesive residue at that time. Contractors shall only use manufacturer authorized cleaning materials for removing adhesives, etc.
 - D. Contractors doing work in un-protected areas of finished work shall be required to provide drop cloths and other protection as noted within this specification for the duration of their work.
 - 1. Finished areas shall be sufficiently covered to accommodate all equipment, and materials being used to complete the work being done.
 - 2. Finished areas shall be sufficiently covered to prevent splatters, over spray, etc when doing touch-up work.
 - 3. Contractors who do not provide sufficient protection under this sub-section shall be responsible for any costs associated with cleaning, repairing or replacing already finished construction at no additional cost to the contract.

END OF SECTION

**SECTION 01 77 00
CLOSEOUT PROCEDURES**

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PART 1 – GENERAL

1.1. SUMMARY

- 21 A. The purpose of this specification is to clearly define and quantify the requirements associated with closing a City
22 of Madison Public Works Contract for facility related work.
23 B. All contracts have two distinct but related paths. Each path needs to be properly closed independently in order
24 to close the contract as a whole.
25 1. Construction closeout is related to closing out all of the Work associated with the construction
26 documents.
27 a. It shall be the responsibility of all contractors to be fully aware of the required Work and closeout
28 requirements involved in their individual trades.
29 2. Contract closeout is related to closing out all of the administrative aspects of the contract in general.
30 a. It shall be the responsibility of all contractors to be fully aware of the administrative requirements
31 required by the contract and to provide the supporting documentation required.
32 3. Construction Closeout must be completed before Contract Closeout can begin.
33 C. This specification will provide general knowledge associated with the following areas:
34 1. Construction Closeout Requirements
35 2. Construction Closeout Procedure
36 3. Contract Closeout Requirements
37 4. Contract Closeout Procedure
38 5. Final Payment and Certificate of Completion
39

1.2. RELATED SPECIFICATIONS

- 41 A. Contractors shall review all references to other specifications including specifications relating to the execution of
42 the Work associated with their Division or Trade.
43 B. Section 01 29 76 Progress Payment Procedures
44 C. Section 01 31 23 Project Management Web Site
45 D. Section 01 32 26 Construction Progress Reporting
46 E. Section 01 45 16 Field Quality Control Procedures
47 F. Section 01 74 13 Progress Cleaning
48 G. Section 01 45 16 Construction Waste Management and Disposal
49 H. Section 01 76 00 Protecting Installed Construction
50 I. Section 01 78 13 Completion and Correction List
51 J. Section 01 78 23 Operation and Maintenance Data
52 K. Section 01 78 36 Warranties
53 L. Section 01 78 39 As-Built Drawings
54 M. Section 01 78 43 Spare Parts and Extra Materials
55 N. Section 01 79 00 Demonstration and Training
56 O. Section 01 91 00 Commissioning
57 P. Other requirements as noted in the contract documents signed by the General Contractor
58

1 **1.3. DEFINITIONS**

- 2 A. **Substantial Compliance:** A letter provided to the City of Madison Building Inspection and signed by the Project
3 Architect indicating that all Work has been completed to a level that would allow Owner Occupancy and that all
4 construction is in compliance with the construction documents. A copy of this letter is also provided to the
5 State of Wisconsin Department of Health and Safety as necessary to clear plan review requirements. This letter
6 does not represent construction closeout.
- 7 B. **Certificate of Occupancy:** The Regulatory letter from the City of Madison Building Inspection Department
8 indicating that all regulatory requirements and inspections have been completed and the building may now be
9 occupied for its intended use. This letter does not represent construction closeout.
- 10 C. **Certificate of Substantial Completion:** A letter provided by the Department of Public Works, signed by the City
11 Engineer indicating that Construction activities are substantially complete. This letter does represent
12 construction closeout and the date of this letter begins the date of the Warranty Period.
- 13 D. **Construction Closeout:** The point in the contract where all contractual requirements associated the execution of
14 the Work as described in the plans, specifications, and other documents have been successfully met and the
15 items described in 1.3.A, .B, and .C above have been completed.
- 16 E. **Final Progress Payment:** The progress payment associated with achieving Construction closeout as described in
17 1.3.D above. At this point the contractor may request all monies associated with the contract be paid with the
18 exception of held retainage.
- 19 F. **Contract Closeout:** The point in the contract where all contractual requirements associated with the City of
20 Madison, Board of Public Works contract has been successfully met.
- 21 G. **Final Payment:** The final contract payment submittal that may be approved by the City of Madison after all
22 contractual requirements of the Public Works Contract have been met and any remaining monies (retainage)
23 due to the contractor may be released for the Final Payment.

24
25 **1.4. QUALITY ASSURANCE – CONSTRUCTION CLOSEOUT**

- 26 A. All contractors shall be responsible for properly executing the construction closeout requirements associated
27 with their Work as described in the specifications governing their Work.
- 28 B. The GC shall be responsible for all of the following:
- 29 1. Ensuring that all contractors have met the construction closeout requirements associated with their
30 Work.
- 31 2. Coordinate the collection of all construction closeout deliverables from all contractors, provide the
32 deliverables to the Project Architect and City Project Manager for review as necessary, and ensure all
33 contractors correct deficiencies of deliverables and resubmit as needed for final acceptance.
- 34 3. Ensure all closeout requirements identified in the Construction Closeout Checklist below have been
35 completed as intended by the construction documents.

36
37 **1.5. QUALITY ASSURANCE – CONTRACT CLOSEOUT**

- 38 A. The City of Madison, Department of Civil Rights (DCR) monitors contract compliance for construction and
39 procurement contracts to ensure that local, state and federal regulations are followed by contractors working on
40 City of Madison Public Works (PW) projects. DCR will monitor all PW projects from contract award through the
41 final payment at the close of the project. Contractors will be required to submit reporting paperwork
42 throughout the PW project process.
- 43 1. Contractors are encouraged to visit the web site identified below for additional information, checklists,
44 forms, and other information provided by DCR as it relates to Contract Compliance.
45 <http://www.cityofmadison.com/Business/PW/contractCompliance.cfm>
- 46 2. Questions regarding the process should be directed to parties and offices as identified on the various
47 forms, documents, and instructions or contact:
48 City of Madison, Department of Civil Rights
49 210 Martin Luther King Jr. Blvd., Room 523
50 Madison, WI 53703
51 (608) 266-4910
- 52 B. All Sub-Contractors have submitted the applicable required documents described in item 1.5.D below to the
53 General Contractor (GC) for Contract Closeout.
- 54 C. The GC has submitted the required applicable documents described in item 1.5.D below for all contractors to the
55 appropriate City of Madison Agency per instructions associated with each submittal.
- 56 D. The documents required for submittal to the City of Madison for Contract Closeout may include any/all of the
57 items listed below depending on contract type. It is the sole responsibility of all contractors to know and submit
58 the required and complete documentation in a timely fashion.

- 1 1. Weekly Payroll Reports
- 2 2. Employee Utilization Reports
- 3 3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
- 4 4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
- 5 5. Documentation required for Small Business Enterprise (SBE) goals
- 6 6. Other documents as maybe required or requested through the Finalization Review Process

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. CONSTRUCTION CLOSEOUT CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Construction Closeout Requirements to the GC.
 1. The checklist shall include all items identified within the construction documents that require any of the following (and examples) prior to moving into Contract Closeout Procedures:
 - a. Documents indicating a specified level of performance has been achieved, such as:
 - i. Test reports of all types
 - ii. Startup reports
 - b. Required documentation, such as:
 - i. As-builts and record drawings
 - ii. Operation and maintenance data
 - c. Physical items to be turned over to the owner, such as:
 - i. Attic stock
 - ii. Keys
 - d. Required maintenance completed, such as:
 - i. Ducts cleaned
 - ii. Filters replaced
 - e. Commissioning and LEED related items and submittals
 - f. Owner and Maintenance Training
- B. Each list shall indicate the title of the closeout requirement, the associated specification of the requirement, the required result or deliverable, the responsible contractor(s), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 1. Consolidating all the closeout lists into one master Construction Closeout Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below
 2. Upload the completed checklist to the Contract Closeout-Miscellaneous Documents Library on the Project Management Web Site for review.
 3. Resubmit the checklist as needed after initial reviews have been completed.
- D. The GC shall work with all contractors to amend the Construction Closeout Checklist throughout the execution of the project based on changes and modifications as necessary.

<u>Title</u>	<u>Specification</u>	<u>Description</u>	<u>Responsibility</u>	<u>Completed</u>
Quality Management Observation Reports	01 45 16	All QMO reports have been properly responded to, reviewed and closed by the CPM.	All, GC	
As-Built Drawings	01 78 39	As-Built drawings have been reviewed and accepted per the specification	All, GC	
Testing and Balancing of HVAC	23 09 23	Provide final TnB reports indicating design performance has been achieved	HVAC	

3.2. CONSTRUCTION CLOSEOUT REQUIREMENTS

- A. The timely submittal or completion of closeout requirements shall go hand in hand with the Progress Payment Milestone Schedule that can be found in Specification 01 29 76 Progress Payments. No payments shall be made until all requirements for that payment have been met.
 1. The GC and all major Subcontractors, PA, and CPM, shall review all requirements for Construction/Contract Closeout during two (2) special meetings.

- 1 a. The first meeting shall be held at the 50% Contract Total Payment milestone. This meeting shall
2 discuss the requirements associated with various construction/contract closeout documentation
3 and events when they are due with respect to progress payments.
4 b. The second meeting shall be held at the 70% Contract Total Payment milestone. This meeting
5 shall review the contractors progress regarding the closeout checklist, begin making plans for
6 upcoming deadlines such as scheduling training, where to put attic stock, and when they are due
7 with respect to progress payments.
8 2. The GC, PA, and CPM, shall utilize the Construction Closeout checklist to ensure that all construction
9 closeout requirements have been met.

10
11 **3.3. CONSTRUCTION CLOSEOUT PROCEDURE**

- 12 A. Upon successful completion and final acceptance of all Construction Closeout Requirements the GC may submit
13 to the CPM and PA the request for Final Progress Payment (100% contract total, less retainage).
14 B. The PA will confirm with the design consultants, CPM, and other City of Madison staff that all requirements of
15 the Work have been completed and will do the following:
16 1. Approve the final progress payment application
17 2. Provide the required signed payment documents to the CPM
18 3. Provide the required Letter of Substantial Compliance to the following as required:
19 a. State Safety and Building Division
20 b. Local Building Inspection office
21 c. GC
22 d. CPM
23 C. The CPM shall draft the City Letter of Substantial Completion for signature by the City Engineer. This letter shall
24 state any of the following that may still be tied to the contract and/or warranty:
25 1. Indicate that the date of the letter shall also be the beginning of the Warranty period.
26 2. Indicate any allowed due outs, reasons for them, and anticipated dates of finalization.
27 a. QMO issues such as off season testing of equipment
28 b. Off season training of equipment
29 D. The GC and all subcontractors shall finalize all warranty letters associated with their Work using the date noted
30 on the City Letter of Substantial Completion, and provide the CPM with all warranties as described in
31 Specification 01 78 36 Warranties. Upon receipt and final approval of the Warranties the CPM may initiate final
32 processing of the Final Progress Payment (100% contract total, less retainage).
33

34 **3.4. CONTRACT CLOSEOUT REQUIREMENTS**

- 35 A. The GC and all sub-contractors shall follow all requirements associated with documenting contract compliance
36 and provide documentation as required or requested by DCR or PW staff. All contractors are encouraged to stay
37 current with submissions of the following documentation:
38 1. Weekly Payroll Reports no later than the Progress Payment equal to 50% of the contract total.
39 2. Employee Utilization Reports
40 3. Agent or Subcontractor Affidavit of Compliance with Prevailing Wage Rate Determination
41 4. Prime Contractor Affidavit of Compliance with Prevailing Wage Rate Determination
42 5. Documentation required for Small Business Enterprise (SBE) goals
43 6. Other documents as maybe required or requested through the Finalization Review Process
44 B. Near the Progress Payment equal to 80% of the contract total the GC shall request in writing a Finalization
45 Review. At that time DCR or PW staff shall prepare a report of all contract documentation submitted to date. A
46 list of missing items or outstanding issues will be emailed to the GC. No additional follow-up will be generated
47 by DCR or PW Staff.
48

49 **3.5. CONTRACT CLOSEOUT PROCEDURE**

- 50 A. The Contract Closeout Procedure will not begin until the Construction Closeout Procedure has been completed.
51 B. When the GC feels he/she has successfully met all of the Contract Closeout Requirements associated with
52 Section 3.3 above the GC may submit to the request for Final Payment to the CPM.
53 C. The CPM shall sign and submit the Final Payment request for processing.
54 D. DCR and PW staff shall do a complete review of all documentation associated with item 3.3.A above.
55 E. The GC shall be notified directly by DCR or PW Staff of any documentation that may still be missing, have
56 incomplete information, or other outstanding issues. It shall be the responsibility of the GC to continue follow-
57 up with DCR and PW staff until all documentation has been successfully submitted and accepted.

- 1 F. When all required documentation associated with Contract Closeout has been successfully submitted and
2 accepted by DCR and PW Staff the City of Madison shall process the Final Payment of any remaining monies
3 including retainage.
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**SECTION 01 78 13
COMPLETION AND CORRECTION LIST**

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PART 1 – GENERAL 1
1.1. SUMMARY 1
1.2. RELATED SPECIFICATIONS 1
PART 2 – PRODUCTS – THIS SECTION NOT USED 1
PART 3 – EXECUTION – THIS SECTION NOT USED 1

PART 1 – GENERAL

1.1. SUMMARY

- A. The City of Madison has developed a multi-faceted Quality Management Program that begins with contract signing and runs through contract closeout to ensure the best quality materials, workmanship, and product are delivered for the contracted Work.
 - 1. The Progress Management Web Site is a Construction Management tool that provides contractors, consultants, and staff a single on-line location for the daily operations and progression of the Work.
 - 2. The Quality Management Observation (QMO) is an ongoing observation of the construction process as it progresses. The City of Madison does not use a "Punch List" or "Corrections List" as it is typically known throughout the construction industry. The QMO process acts as an "in progress punch list". Work identified as not in compliance with the contract documents by the Owner, Owner Representatives, Owner Consultants, etc. shall be resolved immediately at the Contractor's expense. Unresolved issues will be subject to withholding of progress payment(s) until completed.
 - 3. Very stringent expectations are tied to Construction Closeout and Contract Closeout procedures. Specific milestones throughout the project need to be met and the milestones are tied to the Progress Payment Schedule.
- B. All contractors shall be required to review the specifications identified in Section 1.2 below, and other related specifications identified therein to become familiar with the terminology and expectations of this City of Madison Public Works contract.

1.2. RELATED SPECIFICATIONS

- A. Section 01 29 76 Progress Payment Procedures
- B. Section 01 31 23 Project Management Web Site
- C. Section 01 45 16 Field Quality Control Procedures
- D. Section 01 77 00 Closeout Procedures

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 – EXECUTION – THIS SECTION NOT USED

END OF SECTION

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**SECTION 01 78 23
OPERATION AND MAINTENANCE DATA**

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14 3.3. O&M DATA FINAL SUBMITTAL 3
15 3.4. CONSTRUCTION CLOSEOUT 3
16

PART 1 – GENERAL

1.1. SUMMARY

- A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing well documented and complete Operation and Maintenance (O&M) Data related to general facility use, equipment, systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as needed.
- B. Operation and Maintenance Data shall apply to both of the following categories except where specific requirements are noted under their separate titles as follows:
1. Operation and Maintenance Data: Generally shall mean the owner manual that provides information on start-up, shut-down, operation, troubleshooting, maintenance, parts, and other such documentation as it pertains to all equipment and systems installed under the Work.
 2. Use and Care instructions: Where applicable use and care instructions shall also be considered O&M for such things as flooring, tile, partitions, and other such finishes and trim related items, installed under the Work.

1.2. RELATED SPECIFICATIONS

- | | | |
|----|--|--------------------------------|
| A. | Section 01 29 76 | Progress Payment Procedures |
| B. | Section 01 31 23 | Project Management Web Site |
| C. | Section 01 77 00 | Closeout Procedures |
| D. | Section 01 78 13 | Completion and Correction List |
| E. | Section 01 78 19 | Maintenance Contracts |
| F. | Section 01 78 36 | Warranties |
| G. | Section 01 79 00 | Demonstration and Training |
| H. | Section 01 91 00 | Commissioning |
| I. | Other Divisions and Specifications that may address more specifically the requirements for O&M Data. | |

1.3. QUALITY ASSURANCE

- A. All O&M Data shall meet the requirements identified in Section 1.4 below.
- B. All contractors shall provide O&M Data for each piece of equipment, system, or finish installed during the installation of the Work. O&M Data shall be provided to the General Contractor (GC) for verification and submittal.
- C. The GC shall be responsible for receiving all required O&M Data files from all contractors for verifying that all files submitted meet the requirements in Section 1.4 below.

1.4. O&M DATA REQUIREMENTS

- A. O&M Data shall be provided in digital PDF format as follows:
1. PDF files shall be complete first generation consumer useable editions of PDF documents as provided by any of the following:
 - a. Product manufacturer
 - b. Supplier of product
 - c. Product manufacturer internet site

- 1 2. Acceptable PDF files shall have the following functionality:
- 2 a. Word searchable
- 3 b. Key areas are bookmarked
- 4 c. Table of Contents and/or Index linked to content is preferred whenever possible.
- 5 3. Scanned printed material, with word searchable capabilities, saved as a PDF, is not acceptable and will be
- 6 rejected without further review.
- 7 B. O&M Data shall include but not be limited to the following manufacturers' published information as appropriate
- 8 for the equipment, system, material, or finish:
- 9 1. Installation instructions
- 10 2. Parts lists, assembly diagrams, explosion diagrams
- 11 3. Wiring diagrams
- 12 4. Start-up, shut-down, troubleshooting and other related operation procedures
- 13 5. Lubrication, testing, parts replacement, and other such maintenance procedures
- 14 6. General use, care, and cleaning instructions
- 15 7. Special precautions and safety requirements
- 16 8. A list of certified equipment vendors, service companies, parts suppliers including company name,
- 17 address, and phone number
- 18 9. A list of the recommended spare parts to have on hand at all times
- 19 10. A list by type of all recommended lubes, oils, packing material, and other maintenance supplies
- 20 11. Copies of final test reports, balance reports, and other related documentation
- 21 12. Warranty information for equipment and systems
- 22

23 **1.5. O&M DATA SUBMITTALS**

- 24 A. O&M Data shall be prepared as identified in this specification and shall be submitted for review as per the
- 25 schedule identified in Specification Section 01 29 76, Progress Payment Procedures.
- 26 B. O&M Data Draft submittals will be reviewed for content, procedure, and compliance only. A general critique
- 27 with recommendations for improvement will be made but re-submittals will not be required.
- 28 C. O&M Data Final submittals will be reviewed for content, procedure, and compliance. Re-submittals will be
- 29 required until such time as each submittal is accepted.
- 30

31 ***NOTE:** Acceptance of O&M Data Final submittals is required to be complete prior to scheduling and conducting owner*

32 *related training and construction closeout.*

33

34 **PART 2 – PRODUCTS – THIS SECTION NOT USED**

35 **PART 3 - EXECUTION**

36 **3.1. O&M DATA PREPARATION - GENERAL**

- 39 A. All contractors shall prepare O&M Data for draft and final submission as follows:
- 40 1. Obtain digital PDF files for each piece of equipment, system, material or finish as described in Sections
- 41 1.4.A.1 and 1.4.A.2 above.
- 42 2. Verify that all information as described in Section 1.4.B above is included with the PDF file. Obtain
- 43 missing information as necessary for a complete submittal.
- 44 B. Rename each individual PDF file as follows.
- 45 1. Do not use special characters such as #, %, &, /, etc. These characters are reserved by the Project
- 46 Management Web Site software the City of Madison uses; however the under-score (or under-bar) '_' is
- 47 an allowed character.
- 48 2. Use the following format and examples for renaming your file:
- 49 a. Format: ***Equipment name_What_Project name_Contract number_Year***
- 50 i. *Equipment Name* represents the name of any equipment, system, material or finish as
- 51 designated in the Contract Documents.
- 52 ii. *What* represents what the file is about
- 53 iii. *Project Name* represents the title of the project or contract. A shortened version of the
- 54 title may be identified by the City Project Manager to be used by all contractors.
- 55 iv. *Contract number* is the specific identification number the Work was bid under and appears
- 56 on the plan set title sheet and in each sheet title block
- 57 v. *Year* represents the year the contract will be closed out
- 58 b. Examples of file names

- 1 i. AHU 2_Operation Manual_Fire Admin_1234_2015
 2 ii. CPT 2_Use and Care_MPD West_9876_2011
 3 C. All contractors shall submit the completed digital PDF files to the GC in sufficient time for the GC to meet the
 4 O&M Data submission deadlines as described in Specification Section 01 29 76, Progress Payment Procedures.
 5 D. O&M Data shall be submitted and reviewed as described in sections 3.2 and 3.3 below.
 6

7 **3.2. O&M DATA DRAFT SUBMITTAL**

- 8 A. All contractors shall prepare and submit the following for an O&M Data Draft review submittal:
 9 1. Prepare three (3) complete O&M Data file samples as described in section 3.1 above.
 10 2. Review all specifications within his/her Division of Work and prepare a complete O&M Data checklist
 11 listing all equipment, systems, materials, or finishes. Checklist shall be in tabular form similar to the
 12 example below and shall indicate the title (and plan identifier when applicable) of the O&M Data, the
 13 associated specification, and a column to verify the item has been turned in and completed.
 14 B. The GC shall be required to review all contractors' samples and checklists for compliance with this specification
 15 and shall return any to the originating contractor that are insufficient for re-submittal.
 16 1. When acceptable to the GC, he/she shall upload each O&M Data draft submittal file to the O&M Draft
 17 library on the Project Management Web Site.
 18 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
 19 O&M Data draft submittals and checklist within fifteen 15 working days as follows:
 20 1. Provide general critique comments by Division on O&M Data samples submitted. Critique is intended to
 21 provide all contractors with information on strengths and weaknesses of their submittals.
 22 a. Re-submittal of the O&M Data samples will not be required.
 23 2. Review in detail the O&M Data Checklist for completeness. Provide comments as needed.
 24 a. Re-submittal of the O&M Checklist will be required until accepted.
 25

<u>Title</u>	<u>Specification</u>	<u>Completed</u>
Overhead Door Operator	08 36 00	
Air Handling Unit (AHU-3)	23 00 00	
Water Heater (WH-1)	22 30 00	

26
 27 **3.3. O&M DATA FINAL SUBMITTAL**

- 28 A. All contractors shall prepare and submit the following for an O&M Data Final review submittal:
 29 1. Prepare complete O&M Data files as described in Section 3.1 above according to their approved checklist
 30 as described in Section 3.2 above.
 31 2. Submit completed checklist and all final O&M Data files to the GC for final submittal review.
 32 B. The GC shall be required to spot check all contractors' submittals for completeness against their checklists and
 33 for compliance with this specification and shall return any to the originating contractor that are insufficient for
 34 re-submittal.
 35 1. When acceptable to the GC, he/she shall upload each O&M Data final submittal file to the O&M Final
 36 library on the Project Management Web Site.
 37 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
 38 O&M Data final submittals and checklist within fifteen (15) working days as follows:
 39 1. Review the files submitted against the checklist and request any missing files through the GC.
 40 2. Review in detail all of the O&M Data files for completeness.
 41 a. Submittals shall be accepted or rejected as individual PDF files.
 42 b. Contractors shall re-submit entire O&M submittal if any portion is rejected or incomplete.
 43

44 **3.4. CONSTRUCTION CLOSEOUT**

- 45 A. All contractors shall review Specification 01 77 00, Closeout Procedures and Specification 01 79 00
 46 Demonstration and Training.
 47 1. Acceptance of all final O&M Data submittals is required prior to scheduling Demonstration and Training
 48 Sessions.
 49 2. Completion of all Demonstration and Training Sessions is required to receive the Substantial Compliance
 50 for Occupancy Certificate, and to begin Construction Closeout procedures.
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SECTION 01 78 36
WARRANTIES

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14 3.4. FINAL WARRANTY SUBMITTAL 4
15 3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP 4
16

PART 1 – GENERAL

1.1. SUMMARY

- 19
20 A. The purpose of this specification is to provide clear responsibilities and guide lines related to providing all
21 Warranties and Guarantees related to the Work, workmanship, materials, equipment, and other such items
22 required by the Construction Documents.
23 B. Manufacturers’ disclaimers and limitations on product warranties do not relieve any contractor of the warranty
24 on the Work that includes the product.
25 C. Manufacturers’ disclaimers and limitations on product warranties do not relieve suppliers, manufacturers and
26 any contractor required to provide special warranties under the contract documents.
27

1.2. RELATED SPECIFICATIONS

- 28
29 A. Section 01 29 76 Progress Payment Procedures
30 B. Section 01 31 23 Project Management Web Site
31 C. Section 01 77 00 Closeout Procedures
32 D. Section 01 78 23 Operation and Maintenance Data
33 E. Section 01 91 00 Commissioning
34 F. Other Divisions and Specifications that may address more specifically the requirements for Warranties related to
35 the installation of all items and equipment installed under the execution of the Work.
36

1.3. DEFINITIONS

- 37
38 A. See specification 01 77 00 for the definitions of the following terms that may also be used in this specification:
39 1. Substantial Compliance
40 2. Certificate of Occupancy
41 3. Certificate of Substantial Completion
42 4. Construction Closeout
43 5. Contract Closeout
44 B. Emergency Repair: The Owner or Owner Representative reserves the right to make emergency repairs as
45 required to keep equipment or materials in operation or to prevent damage to property and injury to persons
46 without voiding the contractors warranty or bond or relieving the contractor of his/her responsibilities during
47 the warranty period.
48 C. Installer: The company or contractor hired to install a finished product that was manufactured and supplied
49 specifically for the Work within this contract. The Installer may or may not be the same company that supplied
50 the product. See the definition for supplier.
51 D. Supplier: Any company that makes a specific finished product for the Work from information within the Contract
52 Documents. Examples of suppliers would include custom cabinets, steel stairs and railings, etc. A supplier would
53 not be a company that distributes items manufactured by others such as an electrical or plumbing supplier.
54 E. Warranty: A written guarantee from the manufacturer to the owner on the integrity of a product and its
55 installation, and the manufacturers’ responsibility to repair or replace the defective product or components
56 within a specified time from the date of ownership. Warranty may also be used interchangeably with
57 Guarantee. The following warranty types may be part of any specification within the Work associated with the
58 Construction Documents:

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1. Expressed Warranty: A warranty that provides specific repair or replacement for covered components of a product over a specified length of time.
 2. Implied Warranty: A warranty that is not stated explicitly by a seller or manufacturer that the product is merchantable and fit for the intended purpose.
 3. Standard Product Warranty: Preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner. Standard warranties may be for any amount of time but shall not be for anything less than one (1) year from the warranty date.
 4. Special Warranty: A written warranty required by the Contract Documents either to extend the time limit provided under a standard warranty or to provide greater rights to the Owner.
- F. Warranty Date: The effective date that begins all warranty periods required for products, installations, and work-manship associated with the execution of the Work for this contract. The Warranty Date shall be set by the CPM.
- G. Related Damages and Losses: When correcting failed or damaged Warranted Work, remove and reinstall (or replace if necessary) the construction that has been damaged as a result of the failure or the construction that must be removed and replaced to obtain access for the correction of Warranted Work.
- H. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected reinstate the warranty by a new written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation unless specifically noted otherwise in a specification.
- I. Replacement Cost: All costs that may be associated with Work being replaced under warranty including but not limited to the following:
1. Related damages and losses
 2. Labor, material and equipment
 3. Permits and inspection fees
 4. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- J. Replacement Work: All materials, products, required labor, and equipment necessary to replace failed or damaged warranted to an acceptable condition that complies with the requirements of the original Construction Documents.
- K. Owners Recourse: Expressed warranties made to the Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law. Expressed warranty periods shall not be interpreted as limitations on the time in which the Owner can enforce such other duties, obligations, rights, and remedies.
1. Rejection of Warranties: The Owner reserves the right to reject any warranty and to limit the selection of products with warranties not in conflict with the requirements of the contract documents.
 2. Where the Contract Documents require a Special Warranty or similar commitment on the Work or product, the Owner reserves the right to refuse acceptance of the Work until the Contractor presents evidence the entities required to countersign such required commitments have done so.

1.4. GENERAL CONTRACTORS RESPONSIBILITIES

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- A. The General Contractor (GC) shall be responsible to remedy, at his/her expense, any defect in the Work and any damage to City owned or controlled real or personal property when the damage is a result of:
1. The GC's failure to conform to Contract Document requirements.
 - a. Any substitutions not properly approved and authorized may be considered defective.
 2. Any defect in workmanship, materials, equipment, or design furnished by the GC or Sub-contractors.
- B. All warranties as described in this specification and these Contract Documents shall take effect on the date established by the CPM, as noted in Section 1.3F above.
1. All warranties shall remain in effect for one (1) year thereafter unless specifically stated otherwise in the Contract Documents or where standard manufacturer warranties are greater.
- C. The GC's warranty with respect to Work repaired or replaced, including restored or replaced Work due to damage, will run for one (1) year from the date of Owner Acceptance of said repair or replacement.
1. This shall be regardless of any benefit the Owner may have had from the Work through any portion of its anticipated useful service life.
- D. Warranty Response
1. See Section 3.5 of this specification.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. WARRANTY CHECKLIST

- A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work to provide a complete and comprehensive list of all Warranty Requirements to the GC.
- B. Each list shall indicate the title (and plan identifier when applicable) of the warranted item, the associated specification of the warranted item, the terms of the warranty (years), and a column to verify the item has been turned in and completed.
- C. The GC shall be responsible for all of the following:
 - 1. Consolidating all the warranty lists into one master Warranty Checklist.
 - a. The checklist shall be in a tabular data format similar to the sample below.
 - 2. Upload the completed checklist to the Submittal Library on the Project Management Web Site for review. See Specification 01 33 23 Submittals for more information on this procedure.
 - 3. Resubmit the schedule as needed after initial reviews have been completed.
- D. The GC shall work with all contractors to amend the Warranty Checklist throughout the execution of the project based on changes and modifications as necessary.

<u>Title</u>	<u>Specification</u>	<u>Terms</u>	<u>Completed</u>
Overhead Door Operator	08 36 00	MFR 2yr	
Exterior Bench and Trash Receptacles	12 93 00	MFR 3 year warranty on finish	
Kitchen Sink (SK-1)	22 42 00	MFR 5 year	
Disposal (D-1)	22 42 00	MFR 7 year parts and in-home service	
Toilet (WC-1)	22 42 00	MFR 1 year limited	

3.2. LETTERS OF WARRANTY

- A. All letters of warranty shall be in a typed letter format and provide the following information:
 - 1. The letter shall be on official company stationary including company name, address, and phone number.
 - 2. Indicate project name, contract number, and contract address the warranty is for on the reference line.
 - 3. Provide a description of the warranty(ies) being provided.
 - a. Include Division, Trade, or Specification information as necessary.
 - b. Only combine warranties of related Divisional Work together. Create new letters for additional Divisions as necessary.
 - 4. Indicate the effective Warranty Date. As noted in Section 1.3.F above, the Warranty Date shall be the date the Certificate of Substantial Completion was signed by the City Engineer.
 - 5. Contractor Letters of Warranty shall only be signed by a principal officer of the company.
 - 6. After signing the letter provide the GC with a high quality color scanned image in PDF format and the original signed letter.
- B. The GC shall be responsible for the Final Warranty submittal as identified in Section 3.4 below.
- C. The GC shall obtain letters of warranty from all of the following:
 - 1. The General Contractor shall provide warranty letters for all Work that was self performed under the contract documents, identify all trades or Divisions of Work.
 - 2. All Sub-contractors shall provide warranty letters for Work performed under the contract documents; identify all trades or Divisions of Work.
 - 3. Suppliers, as required by other specifications within the Construction Documents where the manufacture of a specific product unique to the Work of this contract was required.
 - a. The terms and conditions of the Supplier Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair, or replace defective materials and workmanship within one (1) year of the warranty date.
 - b. When the supplier is also the installer a single written letter may be submitted identifying both the warranty for the manufacture of the product and the warranty for the installation of the product.
 - 4. Installers as required by other specifications within the Construction Documents where the installation of a specific product unique to the Work of this contract was required.
 - 1. The terms and conditions of the Installer Letter of Warranty shall be as defined by the specifications associated with the Work but shall not be less than the industry standard of repair,

- 1 or replace defective materials and workmanship associated with the installation of the product
2 within one (1) year of the warranty date.
3 5. Special Letters of Warranty shall be required from any contractor, supplier, installer or manufacturer who
4 agrees to provide warranty services required by any Division Specification in excess of their Standard
5 Product Warranty.
6

7 **3.3. STANDARD PRODUCT WARRANTY**

- 8 A. All contractors shall be responsible for collecting and providing copies of all standard product warranties for
9 commercially available products purchased and installed under this contract.
10 B. Only one copy of the manufacturers' standard warranty needs to be submitted as representative for all
11 quantities of the same model number used throughout the Work.
12 C. Provide the manufacturers certificate, letter, or other standard documentation for each Standard Product
13 Warranty submitted as follows:
14 1. Whenever possible a PDF version of the document shall be used.
15 a. If a PDF version is used all additional information shall be completed using simple PDF editing
16 tools such as text boxes, highlight, etc.
17 b. If a PDF version is not available and an original document is furnished the additional information
18 shall be neatly hand written and highlighted on the document in such a fashion so that it does not
19 obscure any part of the written warranty.
20 2. Provide the following additional information on each warranty document:
21 a. Contract warranty date.
22 b. Provide the manufacturer name and model number of the product if not specified within the
23 warranty.
24 i. Where the manufacturer name and model number is specified within the warranty it shall
25 be highlighted for visibility.
26 c. Provide the plan identifier (LAV-1, WC-2, etc) when applicable.
27 D. Each completed warranty shall be saved as a digital PDF. The file shall be named using the specification number
28 and item description. I.E. 22 42 00 Toilet (WC-1).pdf
29 a. Where an original certificate was furnished provide a high quality colored scan of the completed
30 document with the additional information. Save the scanned image in PDF format and use the
31 same naming convention as indicated above.
32 E. Provide all PDF files and any original documents to the GC for final consolidation to be provided to the Owner.
33

34 **3.4. FINAL WARRANTY SUBMITTAL**

- 35 A. The GC shall receive all required warranties (digital PDF and any original documents) from all contractors,
36 suppliers, installers and manufacturers.
37 B. The GC shall inventory all received warranties with the Warranty Submittal List to ensure all required warranties
38 have been received and all warranty periods are correct according to the specifications.
39 C. Provide with each Operation and Maintenance Manual a complete copy of any associated warranty.
40 D. Scan all warranties into a single organized electronic PDF file as follows:
41 1. Organize the PDF file into an orderly sequence based on the table of contents of the Specifications.
42 2. Provide a typed Table of Contents for the entire file at the front of the document.
43 3. Provide bookmarks and links to each individual PDF to enable quick navigation through the PDF
44 document.
45 E. Upload the warranty submittal to the appropriate document library on the Project Management Web Site for
46 review by the PA and CPM.
47 F. Correct any deficiencies or omissions and resubmit as necessary.
48

49 **3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP**

- 50 A. Warranty Notification:
51 1. The City of Madison, Project Management Web Site, uses an email notification system for all warranty
52 related issues. The GC will be required to provide, and keep current during the warranty period, a
53 minimum of two (2) email addresses and phone numbers of current employees to receive email
54 notifications and provide response regarding Work associated with these construction documents.
55 a. In the event a Warranty Issue is deemed by the City of Madison to be an emergency, the GC shall
56 first receive a phone call with a follow-up email from the Project Management Web Site.
57 b. The Contract Closeout-Warranty Issue Library on the Project Management Web Site uses a form
58 for each warranty issue that is logged into the system.

- 1 i. The GC shall open each warranty issue form, review the issue description and any attached
- 2 documentation or photos.
- 3 ii. The GC shall also notify any other sub-contractor, supplier, or installer that may be
- 4 required to review the warranty issue.
- 5 B. Warranty Response:
- 6 1. The GC shall upon notification by the City of Madison provide warranty response as follows:
- 7 a. Critical Systems or equipment: Where damage to equipment and other building components, or
- 8 injury to personnel is probable provide immediate emergency shut-down information and an on-
- 9 site response team as soon as possible but in no case shall on-site response exceed 24 hours.
- 10 b. For non-critical responses where damage or injury is unlikely provide on-site response no later
- 11 than the next business day.
- 12 c. Where Technical Assistance support is part of the written warranty provide all assistance
- 13 necessary via phone, text, or internet systems as indicated by the warranty. If issues cannot be
- 14 resolved provide on-site response no later than the next business day.
- 15 d. If the request cannot be supported in sufficient time as outlined above the Owner (or Owner
- 16 Representative) reserves the right to contact other contractors or service companies having
- 17 similar capability to expedite the repair or replacement and shall invoice all associated costs to
- 18 the Owner back to the GC.
- 19 C. Warranty Execution:
- 20 1. The GC shall provide all repairs or replacements as necessary to restore broken or damaged Work to the
- 21 original level of acceptance as intended by the Contract Documents.
- 22 a. Provide all materials, equipment, products, and labor necessary to complete the repair or
- 23 replacement associated with the Warranty Issue.
- 24 b. Provide all cleaning services as may be required before, during, and after the repair or
- 25 replacement as per Specification 01 74 13 Progress Cleaning.
- 26 c. Provide any protection necessary for existing construction as per Specification 01 76 00 Protecting
- 27 Installed Construction
- 28 d. Provide new letters of warranty when required.
- 29 D. Warranty Follow-up:
- 30 1. Logged Warranty Issues:
- 31 a. The GC shall provide complete documented responses of all logged Warranty Issues. Responses
- 32 shall provide a description of work completed, by who, inclusive dates, and photos of completed
- 33 or repaired work.
- 34 i. Provide call back response if work is not acceptable.
- 35 b. The City Project Manager shall review the submitted response documentation and do a field
- 36 inspection if necessary.
- 37 i. If work is not acceptable, contact GC to review details and expectations of the repair as
- 38 needed.
- 39 ii. If work is acceptable close the Warranty Issue.
- 40 2. Quarterly Warranty Reviews:
- 41 a. The GC shall be responsible for scheduling quarterly on-site review with all of the following:
- 42 i. City Project Manager, and other City staff as needed
- 43 ii. Owner and Owner Tenant Representative
- 44 iii. Commissioning Agent (CxA)
- 45 iv. Plumbing, Heating, Electrical Sub-contractors
- 46 v. Other Sub-contractors that may be responsible for open Warranty issues
- 47 b. Quarterly reviews shall be scheduled at 3 months, 6 months, and 11 months after the effective
- 48 date of the warranty. The review meetings shall:
- 49 i. Review the status of all open Warranty Issues, determine course of action and estimated
- 50 date of completion.
- 51 ii. In the appropriate quarter, provide shut-down, start-up, testing, and training of off-season
- 52 equipment as required by the contract documents.
- 53 iii. The 11th month review shall review all open Warranty Issues, final plan for resolution, and
- 54 all Warranty Issues where a new letter of warranty may have been issued.
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END OF SECTION

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**SECTION 01 78 39
AS-BUILT DRAWINGS**

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PART 1 – GENERAL

1.1. SUMMARY

- 22 A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they
23 pertain to City of Madison contract procedures regarding the accurate recording of the Work associated with the
24 execution of this contract. This shall include but not be limited to work that will be hidden, concealed, or buried.
25 B. Each contractor shall be responsible for maintaining an accurate record of all installations, locations, and
26 changes to the contract documents during the execution of this contract as it may relate to their specific division
27 or trade.
28 C. The General Contractor (GC) shall be responsible for ensuring all contractors provide as-built record information
29 to the Master As-Built Document Set as described in this specification.
30

1.2. RELATED SPECIFICAITONS

- 32 A. 00 31 21 Survey Information
33 B. 01 26 13 Request for Information
34 C. 01 31 23 Construction Bulletin
35 D. 01 32 33 Photographic Documentation
36 E. 01 26 63 Change Orders
37 F. 01 29 76 Progress Payment Procedures
38 G. 01 31 23 Project Management Web Site
39 H. 01 33 23 Submittals
40 I. 01 77 00 Closeout Procedures
41 J. 01 91 00 Commissioning
42 K. Other Divisions and Specifications that may address more specifically the requirements for field recording the
43 installation of all items associated with the execution of this contract by Division or Trade.
44

1.3. RELATED DOCUMENTS

- 46 A. Other related documents shall include but not be limited to the following:
47 1. Bidding documents including drawings, specifications, and addenda.
48 2. Required regulatory documents of conditional approval.
49 3. Field orders, verbal or written by inspectors having regulatory jurisdiction.
50 4. Shop drawings and installation drawings.
51

1.4. PERFORMANCE REQUIREMENTS

- 53 A. The GC shall be responsible for maintaining the “Master As-Built Document Set” in the job trailer at all times
54 during the execution of this contract. This document set shall include all of the following:
55 1. Master As-Built Plan Set
56 2. Master As-Built Specification Set
57 3. Other Document Sets

- 1 B. The GC shall designate one person of the GC staff to be responsible for maintaining the Master As-Built
2 Document Set at the job trailer. This shall include, posting updates, revisions, deletions and the monitoring of all
3 contractors posting as-built information as described in this specification.
4 C. All contractors shall use this specification as a general guideline regarding the requirements for documenting
5 their completed Work. Contractors shall explicitly follow additional specification requirements within their own
6 Division of Trade as it may apply to this specification.
7

8 **1.5. QUALITY ASSURANCE**

- 9 A. The GC shall be responsible for all of the following:
10 a. Spot checking all sub-contractors field documents to insure daily information is being recorded as
11 work progresses.
12 b. Discuss as-built recording to the plan set at weekly job meetings with all sub-contractors on site.
13 c. Schedule time with sub-contractors in the job trailer for recording as-built information to the plan
14 set.
15 d. Insure that all sub-contractors are providing clear and accurate information to the plan set in a
16 neat and organized manner.
17 e. Insure sub-contractors who have completed work have finalized recording all as-built information
18 to the plan set before releasing them from the project site.
19 B. The Project Architect, the City Project Manager, Commissioning Agent and other design team staff will perform
20 random checks of the Master As-Built Document Set during the execution of this contract to ensure as-built
21 information is being recorded in a timely fashion as the Work progresses. An updated and current Master As-
22 Built Document Set is a stipulation for approval of the progress payment.
23

24 **PART 2 – PRODUCTS**

25
26 **2.1. OFFICE SUPPLIES**

- 27 A. The GC shall provide a sufficient supply of office products in the job trailer at all times for all contractors to use in
28 recording as-built information into the plan set. This shall include but not be limited to the following:
29 a. Red ink pens, medium point. Pens that bleed through paper, markers, and felt tips will not be
30 accepted.
31 b. The use of highlighters is acceptable. Assign colors to various trades for consistency in recording
32 information.
33 c. Straight edges of various lengths for drawing dimension, extension and other lines.
34 d. Civil and Architectural scales
35 e. Clear transparent, non-yellowing, single sided tape.
36 f. Correction tape or correction fluid for correcting small errors.
37

38 **PART 3 - EXECUTION**

39
40 **3.1. FIELD DOCUMENT AS-BUILTS**

- 41 A. The GC and all Sub-contractors shall be responsible for keeping their own field set of as-built documents
42 including plans, specifications and published changes.
43 B. Field sets shall be kept dry and in good condition at all times.
44 C. No Work shall be buried, covered, or hidden, by any additional Work, regardless of Contractor or Trade, until
45 locations of all materials and equipment has been properly documented as described below.
46 D. All contractors shall be required to record the following as-built information:
47 a. Notes on the daily installation of materials and equipment.
48 b. Sketches, corrections, and markups indicating final location, positioning, and arrangement of
49 materials and equipment such as pipes, conduits, valves, cleanouts, pull boxes and other such
50 items. Note all final locations on plan sheets, indicate dimension off identifiable building features.
51 Riser diagrams need only be corrected for significant changes in locations, routing or
52 configuration.
53 i. The use of photographs in lieu of hand drawn sketches is acceptable.
54 ii. Photos shall be taken according to Specification 01 32 33 Photographic Documentation
55 iii. Print photo and markup with dimensions or notes as necessary.
56 c. Identify by the use of existing plan symbology and notes the size, type, quantity, and use as
57 applicable of materials such as pipes, valves, conduits, etc.

- 1 d. Note whether horizontal runs are below slab or above ceiling, include dimensions above or below
2 finished floor elevation.
3 E. All contractors shall be responsible for transferring the information from their field set of documents to the
4 Master As-Built Plan Set kept in the GC job trailer. See Section 3.3.D. below for the proper procedure.
5 F. All contractors shall update the GC Master Plan Set as often as necessary, but not less than once per work week.
6

7 **3.2. SITE SURVEY AS-BUILT**

- 8 A. The Land Surveyor Sub-Contractor shall provide digital as-built information including but not be limited to the
9 following:
10 a. For underground buried utility laterals and services of all types locate all of the following that may
11 apply:
12 i. Connection points at all mains
13 ii. Storm discharge points to open air
14 iii. All corners and bends regardless of angle, large radius sweeps shall have multiple point
15 locations sufficient to define the sweep.
16 iv. All vertical drops
17 v. All wells
18 vi. Private buried utilities such as buried electrical cables, irrigation systems, etc.
19 v. Other information that may need to be located in the future by the owner prior to digging
20 b. Record all surface features including but not limited to the following:
21 i. Building corners, pavement edges, and other permanent structural features.
22 ii. All surface covers for inlets, catch basins, cleanouts, access structures, curb stops and
23 other such devices.
24 iii. Other permanent surface features such as hydrants, lamp posts, and other permanent site
25 amenities.
26 c. The following data shall be recorded while locating items in sub-sections 3.2.a and 3.2.b above:
27 i. Flow lines at both ends of pipes
28 ii. Pipe sizes and material types
29 iii. Rim elevations for all covers
30 iv. Sump elevations and invert elevations of all structures
31 v. Spot elevations for all pads, driveways, walks, stoops, and floors
32 B. The Surveyor shall provide the final digital as-built on a media and in a format specified in Specification 00 31 21
33 Survey Information to the GC for turn in to the Project Architect and the Civil Engineer.
34 C. The Surveyor shall provide two printed as-built site plans to the GC for inclusion in the Master As-Built Plan Set
35 as follows:
36 1. One sheet to show all features (but not contour information) with text neatly organized for each item
37 identified.
38 2. One sheet showing contours, contour labels, and features from item 1 above, but with no additional text.
39

40 **3.3. MASTER AS-BUILT DOCUMENT SET**

- 41 A. The GC shall be responsible for maintaining the Master As-Built Document Set in the job trailer at all times.
42 1. The Master As-Built Plan Set (Plan Set) shall begin with one complete bid set of drawings and any
43 additional sheets that were supplied by published addenda during the bidding process. The cover sheet
44 shall be titled as the "Master As-Built Plan Set" in large bold red letters approximately 2" in height and
45 shall not be used for any other purpose.
46 a. The Plan Set shall be kept dry, legible, and in good condition at all times.
47 b. The Plan Set shall be kept up to date with new revisions within two (2) working days of
48 supplemental drawings being issued. Revisions shall be posted as follows:
49 i. Insert new, revised sheets into the plan set. Void old sheets but do not remove them from
50 the plan set. Indicate date received and what document (RFI, CB, CO, etc) caused the
51 change.
52 ii. Insert new, revised individual details into the plan set. Void old details, tape new details
53 over the old details with a "tape hinge" to allow them to be viewed. Indicate date
54 received and what document (RFI, CB, CO, etc) caused the change.
55 iii. Add new details in appropriate white space on relevant sheets. If no space is available use
56 the back side of the previous sheet or insert a new sheet. Indicate date received and what
57 document (RFI, CB, CO, etc) caused the change.

- 1 c. The Plan Set shall be available at anytime for easy reference during progress meetings and for
2 emergency location information of new work already completed.
- 3 2. The Master As-Built Specification Set (Spec Set) shall begin with one complete bid set of specifications
4 and any additional specifications that were supplied by published addenda during the bidding process.
5 The Spec Set shall be provided in three "D" ring type binders of sufficient thickness to accommodate the
6 specification set. Multiple binders are allowed as necessary. Label the front cover and binding edge with
7 "Master As-Built Specifications" in bold red letters. Provide other information as necessary to distinguish
8 the contents of multi-volume sets.
- 9 a. The Spec Set shall be kept dry, legible, and in good condition at all times.
10 b. The Spec Set shall be kept up to date with new revisions within two (2) working days of
11 supplemental drawings being issued.
- 12 c. The Spec Set shall be available at anytime for easy reference during progress meetings.
- 13 3. Other Document Sets may be kept at the GCs option in three "D" ring type binders of sufficient thickness
14 to accommodate the documentation. Other documentation sets may include but not be limited to RFIs,
15 CBs, COs, etc.
- 16 C. The Land Surveyor Sub-Contractor shall be required to use digital surveying for all exterior site surveying, and
17 provide deliverable digital as-builts as specified in Specification 00 31 21 Survey Information. As soon as practical
18 the surveyor shall provide the GC with a preliminary copy of installed buried utilities for inclusion with the plan
19 set in the job trailer. The surveyor shall provide final digital as builts as per section 3.2 above.
- 20 D. All contractors shall be responsible for updating the Plan Set from their field sets at least once per work week.
21 Updates shall include but not be limited to the following procedures:
- 22 a. All updates shall be done only in red ink. Place a "cloud" around small areas of correction to call
23 attention to the change.
- 24 b. Whenever possible place general work notes, field sketches, supplemental details, photos, and
25 other such information on the reverse side of the preceding sheet. Installation notes including
26 dates shall be kept neatly organized in chronological order as necessary.
- 27 c. Accurately locate items on the plan set as follows:
- 28 i. For items that are located as dimensioned provide a check mark or circle indicating the
29 dimension was verified.
- 30 ii. For items that are within 5 feet of the location indicated on the plans leave as shown and:
31 • Provide correct dimensions to existing dimension strings or,
32 • Accurately locate with new dimension strings
- 33 iii. For items that are more than 5 feet from the location indicated on the plans
34 • Accurately draw the items in the new location as installed and,
35 • Accurately locate with new dimension strings and,
36 • Note that the existing location is void.
- 37 d. Include dimensioned locations for items that will be buried, concealed, or hidden in the ground,
38 under floors, in walls or above ceilings.
- 39 i. Dimensions shall be pulled from identifiable building features, not from centers of columns
40 or other buried features.
- 41 ii. When necessary pull more dimensions as needed from opposing directions to properly
42 locate single items.

43
44 **3.4. AS-BUILT REVIEW AND ACCEPTANCE**

- 45 A. The GC shall provide the Master As-Built Plan Set to the Project Architect (PA), the City Project Manager (CPM),
46 the Commissioning Agent (CxA) and other design team staff for content review prior to the Progress Payment
47 Milestone indicated in Specification 01 29 76 Progress Payment Procedures. The submitted plan set shall include
48 the digital survey information produced under Section 3.2 above.
- 49 1. If the plan set is not approved:
- 50 a. The PA and CPM shall only be required to generalize deficiencies by trade there shall be no
51 requirement or expectation to generate a "punch list" of required corrections.
- 52 b. The GC and Sub-contractors as necessary shall be responsible for inspecting the installation and
53 correcting the drawings as needed.
- 54 c. The GC shall re-submit the plan set for review.
- 55 2. If the plan set is approved the PA shall take possession of the plan set to be used in providing the owner
56 with digital CAD record drawings. Upon completion of transferring the information to CAD the PA shall
57 provide the Owner with CAD record drawings, record PDFs, and the Master As-Built Plan Set.
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3.5. CHANGES AFTER ACCEPTANCE

- A. No Contractor shall be responsible for making changes to the As-Built record documents after acceptance by the PA and CPM except when necessitated by changes resulting from any Work made by the Contractor as part of his/her guarantee.

END OF SECTION

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**SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS**

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PART 1 – GENERAL

1.1. SUMMARY

- 21 A. This specification is intended to provide clear guidelines and identify the responsibilities of all contractors as they
22 pertain to City of Madison contract procedures regarding spare parts, special tools, special materials, and extra
23 materials.
24 B. Each contractor shall be responsible for knowing the specific requirements of their Division Specifications as they
25 may relate to the general information provided in this specification.
26 C. The General Contractor (GC) shall be responsible for ensuring all contractors provide spare parts and extra
27 materials as described in this specification.
28

1.2. RELATED SPECIFICAITONS

- 30 A. 01 29 76 Progress Payment Procedures
31 B. 01 31 23 Project Management Web Site
32 C. 01 77 00 Closeout Procedures
33 D. Other Divisions and Specifications that may address more specifically how to proceed with spare parts, special
34 tools, special materials, and extra materials.
35

1.3. DEFINITIONS

- 37 A. Spare Parts: Any component of a product or assembly that comes pre-packaged or was specially ordered for the
38 explicit use of the product or assembly. This shall include but not be limited to fastening devices, mounting
39 brackets, replacement parts, wheels, pulleys, wiring, alternate assembly pieces, etc.
40 B. Special Tools: Any tool of any kind that was pre-packaged or specially ordered, and is required to be used for the
41 installation or maintenance of an installed product or assembly as part of this contract.
42 C. Special Materials: Any oil, lubricant, glue, touch-up paint, or other such material that comes pre-packaged or
43 was specially ordered and is required to be used for the installation or maintenance of an installed product or
44 assembly as part of this contract.
45 D. Extra Materials (Attic Stock): Any surplus materials in new and useable condition that was installed a part of this
46 contract. Attic Stock shall include but not be limited to the following: ceiling tiles, paint, stain, floor coverings,
47 ceramic tiles, light bulbs/lamps, filters, strainers, etc. Attic Stock shall include partially opened bulk items and
48 additional unopened quantities as directed by other specifications.
49

1.4. PERFORMANCE REQUIREMENTS

- 51 A. All contractors shall be responsible for consolidating spare parts, special tools, special materials, and attic stock
52 as it pertains to the specific Work within their Division or Trade.
53 B. All contractors shall use this specification as a general guideline regarding the requirements for turning spare
54 parts, special tools, special materials, and attic stock over to the owner. Contractors shall explicitly follow
55 specification requirements within their own Division of Trade.
56

1.5. QUALITY ASSURANCE

- 58 A. The General Contractor (GC) shall be responsible for all of the following:

1. Coordinate the location for and the delivery of all spare parts, special tools, special materials, and attic stock being provided by all contractors under this contract to one centralized location as designated by the Owner.
2. Verify that all items being delivered are:
 - a. Clean, new, and in a usable condition.
 - b. Properly sealed, protected, and labeled
 - c. Properly documented

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. PACKAGING

- A. Whenever possible all surplus items should remain in their original packaging such as parts envelopes.
- B. Package small parts in re-sealable plastic bags (Ziploc) or envelopes with clasp fasteners. Do not use envelopes that seal with glue or tape envelopes closed. Do not leave packaging unsealed.
- C. Package like parts together for products or assemblies. I.E. keep all spare parts for flushometers together.
- D. Many small packages may be grouped together into a larger container by trade.
- E. Do not use unrelated boxes or containers for packaging spare items. I.E. do not use a light fixture box for spare breakers, or flushometers parts.

3.2. LABELING

- A. Whenever possible the original labeling indicating part numbers and other pertinent information shall remain on the original packaging.
- B. If original labeling is not available the contractor shall label all parts and packages using tape or labels and permanent black markers. Tape or labels being used shall absorb the permanent marker without bleeding or allowing ink to be smeared or rubbed off.
- C. Labels shall include the name of the product or equipment the item belongs to, part number and/or name, and any other information that would assist maintenance personnel in identifying the piece and related product.
- D. Labels shall include plan or specification designations (WC-1, LAV-3, DF-2, CPT-1, etc) that identify the particular product or finish material it represents.
- E. Labels for parts stored in clear re-sealable plastic bags may be placed inside the bag. Label shall face out and be able to be read from one side. Multiple bags shall be numbered individually for identification.
- F. Label the outside of large containers with the trade name (Plumbing, Electrical, etc).

3.3. INVENTORY

- A. All contractors shall provide the GC with complete inventories of all spare parts, special tools, special materials, and attic stock that they are providing at the end of the contract. The inventories shall be organized as follows:
 1. The cover sheet shall indicate the Contractors name, address, phone number, identify that the document is the "Spare Parts and Extra Materials Inventory", and identify the Division or Trade the inventory is for.
 2. Provide an inventory in a tabular format of all items being provided under this and other specifications. The minimum information to be provided for each item on the inventory shall be as follows:
 - a. Bag or container number, all items of one bag or container shall be grouped together on the inventory
 - b. Item description
 - c. Item size (if applicable)
 - d. Total quantity provided
 - e. Identify if item is a spare part, tool, special material, or attic stock
- B. The GC shall consolidate inventories from all sub-contractors into one tabular data sheet organized by Division or Trade of Work.
 1. Upon completing the consolidated list the GC shall upload the completed inventory to the Contract Closeout-Attic Stock Library on the Project Management Web Site.
 2. The GC shall notify the Project Architect and City Project Manager that the scans have been uploaded.
 3. Consulting Staff and Owner Staff shall review the inventories prior to Final Review to verify that minimum required quantities have been met. Deficiencies shall be noted and returned back to the GC for corrective action.

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3.4. STORAGE

- A. Prior to the 80% Progress Payment milestone the GC shall coordinate with the City Project Manager and Maintenance Personnel where spare parts, special tools, special materials, and attic stock shall be stored.
- B. The GC shall instruct all contractors as to the location and proper storage procedures.
- C. The GC shall be responsible for ensuring the storage area is kept neat and orderly as follows:
 - 1. Like items are stored together by material, product, or trade as necessary.
 - 2. Liquids are stored in sealable containers and the lids have been properly installed to prevent drying out, spillage, etc.
 - 3. All labels are clearly visible and provide the required information.
- D. Large items shall be stored so as not to damage other items. Do not stack heavy items or items with distinct shapes/outlines on softer items that may get crushed or imprinted.

3.5. CLOSEOUT PROCEDURE

- A. Prior to the 90% Progress Payment milestone the GC shall review all attic stock already stored by the contractors to ensure the following:
 - 1. Materials are stored in the proper location(s).
 - 2. All boxes, containers and items are properly labeled according to the submitted/approved inventory.
 - 3. Quantities are correct according to the submitted/approved inventory.
- B. The GC shall ensure that all deficiencies are corrected prior to conducting Demonstration and Training Sessions.
- C. The GC shall review with Maintenance Staff all inventories and labeling during the scheduled Demonstration and Training Sessions.
- D. Any discrepancies associated with Attic Stock shall be resolved and verified prior to the CPM releasing the 90% CT progress payment.

END OF SECTION

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**SECTION 01 79 00
DEMONSTRATION AND TRAINING**

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17 **PART 1 – GENERAL**

18
19 **1.1. SUMMARY**

- 20 A. The purpose of this specification is to provide clear responsibilities and guidelines related to providing
21 Demonstration and Training (D&T) Sessions related to general facility use, equipment, systems, finishes, and
22 materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and Custodial Personnel) as
23 needed.
24 B. All D&T shall be coordinated through the General Contractor (GC), Project Architect (PA) and City Project
25 Manager (CPM), and will be based on or customized to the needs of City of Madison Staff being trained. New
26 equipment and systems may have complete D&T sessions as described in this specification while equipment or
27 systems staff is familiar with may have sessions more focused on maintenance only.
28

29 **1.2. RELATED SPECIFICATIONS**

- 30 A. Section 01 29 76 Progress Payment Procedures
31 B. Section 01 78 13 Completion and Correction List
32 C. Section 01 78 19 Maintenance Contracts
33 D. Section 01 78 23 Operation and Maintenance Data
34 E. Section 01 78 36 Warranties
35 F. Section 01 78 39 As-Built Drawings
36 G. Section 01 78 43 Spare Parts and Extra Materials
37 H. Section 01 91 00 Commissioning
38 I. Other Divisions and Specifications that may address more specifically the requirements for D&T sessions related
39 to the installation of all items and equipment installed under the execution of the Work.
40

41 **1.3. QUALITY ASSURANCE**

- 42 A. All contractors shall have the responsibility of preparing for and conducting D&T sessions as determined by this
43 and other Division or Trade related specifications, Owner Operation and Maintenance Manuals, and other such
44 documentation related to the Work.
45 B. The GC shall have responsibility for:
46 1. Ensuring that all contractors required to conduct a D&T session have successfully completed all of the
47 following:
48 a. Turned in all required documentation for review and documentation has been approved/accepted
49 prior to scheduling D&T sessions.
50 b. Other required documentation as needed is available and ready for use during the D&T session.
51 c. All systems have been started, tested, and running as per appropriate specification and/or
52 manufacturers recommendations prior to scheduling D&T sessions.
53 d. All contractors are sufficiently prepared for their D&T session
54 e. Documents the D&T session including date, time, contractor and company name, attendees and
55 other information regarding the session
56 2. Organizing the coordination and scheduling of all D&T sessions between all contractors and the
57 appropriate representatives of the Owner. These representatives may include any of the following
58 depending on the Work of the Contract:

- a. Owner – end users
- b. Facility Maintenance personnel
 - i. Facility general operation procedures including custodial services
 - ii. Electrical
 - iii. Mechanical
 - iv. Plumbing
 - v. Site
- c. Information Technology (IT) Department
- d. Traffic Engineering – Radio Shop
- e. Architects, Engineers and Facility Management staff as project completion overview

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

- A. The GC shall develop a specific D&T plan to be scheduled and conducted as described below but no sooner than the meeting discussed in 3.2.A.2 below.
- C. The GC shall not schedule D&T sessions to preclude required personnel from attending multiple sessions.

3.2. COORDINATING AND SCHEDULING THE TRAINING

- A. The GC, PA, CxA and CPM, shall review all Training and Demonstration requirements during two (2) special meetings.
 - 1. The first meeting shall be held at the 50% Contract Total Payment. During this meeting the following shall be discussed:
 - a. Preliminary schedule of training dates to be completed prior to beginning construction closeout.
 - b. List of documentation and items that need to be completed and available before and during the training session.
 - c. Who (Owner, Maintenance, etc) will be attending what training session(s).
 - 2. The second meeting shall be held at the 80% Contract Total Payment. This meeting shall review due outs that have not yet been completed for the 90% Contract Total Payment and the requirements necessary for Construction Closeout. All Demonstration and Training sessions shall be completed prior to receiving the 90% progress payment and beginning Construction Closeout Procedures (see Specification 01 77 00).
 - a. This does not include any requirement associated with off season equipment preparation and/or demonstration and Training Sessions.
- B. All of the Construction Work shall be operationally ready prior to conducting training as follows:
 - 1. All contractors shall have their As-Built Drawing Records available for reviewing locations of system components during training.
 - 2. All final and approved Operations and Maintenance Data shall be completed no less than two (2) full weeks prior to the scheduled training.
 - 3. All systems shall have been started, functionally tested, balanced, and fully operational, and all piping and equipment labeling complete at least two (2) days prior to the scheduled training.
 - a. Seasonal equipment shall not be trained out of season. Contractors having seasonal equipment shall work with the GC and CPM for coordinating additional training sessions as appropriate for seasonal equipment.
- C. Correction list items that prevent a piece of equipment or system from being fully operational for training shall be corrected prior to conducting the training.

3.3. TRAINING OBJECTIVES

- A. For each piece of equipment or system installed train on the following objectives/topics as applicable:
 - 1. System design, concept, and capabilities
 - 2. Review of related contractor as-built drawings
 - 3. Facility walkthrough to identify key components of the system
 - 4. System operation and programming including weekly, monthly, annual test procedures
 - 5. System maintenance requirements
 - 6. System troubleshooting procedures
 - 7. Testing, inspection, and reporting requirements associated with any regulatory requirements
 - 8. Identification of any correction list items still outstanding

- 1 9. Review of system documentation including the following:
- 2 a. Operation and maintenance data
- 3 b. Warranties
- 4 c. Valve charts, tags, and pipe identification markers
- 5 B. For each piece of specialty equipment train on the following objectives/topics as applicable:
- 6 1. Manufacturers operations instructions
- 7 2. Manufacturers use and care instructions
- 8 3. Manufacturers maintenance and troubleshooting instructions
- 9 4. System operation and programming including weekly, monthly, annual test procedures
- 10 5. Identification of any correction list items still outstanding
- 11 6. Review of system documentation including the following:
- 12 a. Operation and maintenance data
- 13 b. Warranties
- 14 C. End User Orientation
- 15 1. Facility walkthrough
- 16 2. Security and emergency features
- 17 3. General facility operation procedures
- 18 D. Facility General Use and Custodial Services – if requested
- 19 1. Facility walkthrough
- 20 2. Security and emergency features
- 21 3. General facility operation procedures
- 22 4. Care and maintenance of specialty items, finishes, etc as requested
- 23 5. Attic stock inventory and material designations
- 24

25 **3.4. DEMONSTRATION AND TRAINING PROGRAM PREPARATION**

- 26 A. Each contractor having a responsibility for providing D&T sessions shall meet with the GC, CPM, and other City
- 27 Staff as needed to review the extent of the Training Objectives in section 3.3 above needed for each piece of
- 28 equipment, system, finish, etc. This meeting shall occur no less than four (4) weeks prior to the anticipated
- 29 training session.
- 30 B. The contractor shall use the information from item 3.4.A above to prepare a formal training program for each
- 31 piece of equipment or system based on the Training Objectives in 3.3 above.
- 32 1. The formal training program shall include the following information:
- 33 a. Session title
- 34 b. List of systems, equipment, use, care, etc to be covered during the session
- 35 c. Provide the following for each systems, equipment, use, care, etc to be covered during the session
- 36 i. Name and affiliation of each instructor to be used. As needed and discretion of the Owner
- 37 the GC to require attendance by the installing technician, installing Contractor and the
- 38 appropriate trade or manufacturer’s representative.
- 39 ii. Qualifications of each instructor to be used. Practical building operation expertise as well
- 40 as in-depth knowledge of all modes of operation of the specific piece of equipment as
- 41 installed in this project is required by the training personnel. If Owner determines training
- 42 was not adequate, the training shall be repeated until acceptable to Owner.
- 43 iii. A checklist of all documentation and system/equipment requirements necessary to
- 44 complete a successful training session and the current status of each
- 45 iv. Any additional documents, training aids, video or other items to be used to complete the
- 46 training
- 47 v. Any special requirements or needs associated with item iv above to complete the training
- 48 d. The intended audience for the training
- 49 e. The approximate duration of each objective or topic to be covered
- 50 2. Submit the completed training program to the GC for review and approval by the PA and CPM.
- 51 C. The PA and CPM shall work with staff as necessary to ensure all points of anticipated training needs have been
- 52 met. The PA and CPM will approve the program as submitted or recommend changes for re-submittal as
- 53 necessary.
- 54

55 **3.5. CONDUCTING A DEMONSTRATION AND TRAINING SESSION**

- 56 A. All contractors shall conduct their required D&T Sessions as follows:
- 57 1. Begin with a classroom session
- 58 a. Provide a sign in sheet indicating all training to be conducted, instructors, etc.

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- b. Provide an overview of the training to be conducted including the approximate schedule.
 - 2. Conduct a general walk-through of the site.
 - a. Point out locations of various equipment, valves, charts, and other related items.
 - b. Use the Division or Trade As-Built record drawings to indicate locations of hidden or buried items.
 - 3. Provide a demonstration of general equipment/system operation including using the O&M manual.
 - a. Startup and shutdown procedures.
 - b. Normal operational levels as depicted by any gauges, software, etc.
 - c. Indicate warning devices, signs etc. and demonstrate emergency shut-down procedures.
 - 4. Provide a demonstration of all owner level maintenance using the O&M manual.
 - a. Indicate frequency of maintenance.
 - b. Provide and review all spare parts, special tools, and special materials.
 - 5. Provide and review all spare parts, special tools, special materials, or attic stock as applicable.
 - 6. While conducting D&T sessions:
 - a. Allow hands on training whenever practical.
 - b. Answer questions promptly
 - c. Repeat demonstrations and procedures as necessary.
 - B. Within two (2) working days of completing the D&T session the contractor responsible for the session shall turn-in any documentation generated including the sign in roster to the GC.
 - C. The GC shall turn over all training documentation to the PA and CPM upon completion of D&T sessions.
 - D. Re-schedule any training that has been determined to be inadequate or inappropriate for any reason including but not limited to any of the following;
 - 1. Unqualified instructor
 - 2. System installation incomplete or untested to the specifications
 - 3. Equipment failure during demonstration
 - 4. Un-expected cancellation

3.6. CLOSEOUT PROCEDURE

- A. Prior to receiving the 90% Progress payment the GC shall:
 - 1. Verify with the PA and CPM that each Demonstration and Training Session was conducted properly and according to the submitted plan.
 - 2. Any required "Off Season" equipment testing, balancing, and Demonstration and Training Sessions have been tentatively scheduled with the GC, necessary sub-contractors, instructors and Owner/Owner Representatives as necessary.

END OF SECTION

1 SECTION 018113.13 - SUSTAINABLE DESIGN REQUIREMENTS - LEED 2009 FOR NEW CONSTRUCTION AND MAJOR RENOVATIONS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other
5 Division 01 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and
8 credits needed for Project to obtain LEED Silver certification based on USGBC's "LEED 2009 for New Construction &
9 Major Renovations."

- 10 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and
11 may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain
12 LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and
13 comparable product requests.
14 2. A copy of LEED Project checklist is attached at the end of this Section for information only.

- 15 a. Some LEED prerequisites and credits needed to obtain the indicated LEED certification depend on
16 Architect's design and other aspects of Project that are not part of the Work of the Contract.

17 B. Related Sections:

- 18 1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections.
19 Requirements may or may not include reference to LEED.
20

21 1.3 DEFINITIONS

- 22 A. LEED: USGBC's "LEED 2009 for New Construction & Major Renovations."

- 23 1. Leadership in Energy and Environmental Design. Green Building Rating System representing the US Green
24 Building Council's effort to provide a national standard for what constitutes a "green building".
25 2. The standard requires quantitative and technical documentation to demonstrate compliance with goals
26 described in the US Green Building Council's Green Building Rating System.
27 3. Definitions that are a part of "LEED 2009 for New Construction and Major Renovations" apply to this
28 Section.

- 29 B. Albedo (a.k.a. solar reflectance): The ratio of the reflected electromagnetic energy to the incoming 3
30 electromagnetic energy.

- 31 C. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products was
32 obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC
33 Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified 7
34 for chain of custody by an FSC-accredited certification body.

- 35 D. Emissivity (a.k.a. infrared emittance): A parameter between 0 and 1 that indicates the ability of a material to shed
36 infrared radiation.

- 1 E. Hydrofluorocarbons (HFCs): Refrigerants used in building equipment that do not deplete the stratospheric ozone
2 layer.
- 3 F. Locally-Manufactured (for LEED™ Materials Credit 5): Refers to the final assembly of components into the building
4 product that is furnished and installed by the trades people. For example, if the hardware comes from Seoul, South
5 Korea, the lumber from Vancouver, British Columbia, and the joist is assembled in Kent Washington, then the
6 location of the final assembly is Kent, Washington.
- 7 G. Post-Consumer Recycled Content: The percentage of waste material by weight available from consumer use
8 incorporated into a building material.
- 9 H. Pre-consumer (aka Post-Industrial Recycled) Content: The percentage of waste material by weight available from
10 industrial use incorporated into a building material. Post-industrial recyclable materials are different from industrial
11 scrap, a by-product of industrial processes that can easily be reused as a feedstock.
- 12 I. Potable Water: Water that is suitable for drinking and is supplied from wells or municipal water systems.
- 13 J. Recycling: The collection, reprocessing, marketing and use of materials that were recovered or diverted from the
14 solid waste stream. Note that LEED uses the term "pre-consumer" rather than "post-industrial." Also note that
15 when manufacturers and trade associations use the term "post- industrial" it often includes spills, scraps, and
16 damaged and surplus materials that are fed back into the same manufacturing process and that these materials are
17 not considered recycled content by the LEED rating systems.
- 18 K. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled
19 fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
- 20 L. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and
21 institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
- 22 M. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process.
23 Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being
24 reclaimed within the same process that generated it.
- 25 N. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within
26 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and
27 manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- 28 O. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site.
29 Manufacturing refers to the final assembly of components into the building product that is installed at Project site.
- 30 P. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials
31 that are extracted, harvested, or recovered within a radius of 500 miles from Project site.
- 32 Q. Solar Reflectance: See "Albedo."
- 33 R. Sustainable Forestry: The practice of managing forest resources to meet the long-term product needs of humans
34 while maintaining the biodiversity of forested landscapes. The primary goal is to restore, enhance, and sustain a full
35 range of forest values, both economic and ecological.
- 36 S. Type A Finishes: Material and finishes with potential for short-term levels of off gassing from chemicals inherent in
37 their manufacturing process, or which are applied in form requiring vehicles or carriers for spreading which release
38 high level of particulate matter in process of installation and/or curing. Including, but not limited to:
39
- 40 1. Composite wood products, specifically including particleboard from which millwork, wood paneling, doors,
41 or furniture may be fabricated.
 - 42 2. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
 - 43 3. Wood preservatives, finishes, and paint.

- 1 4. Control and/or expansion joint-fillers.
- 2 5. Hard finishes requiring adhesive installation.
- 3 6. Gypsum board and associated finish processes.

- 4 T. Type B Finishes: Fuzzy material and finishes which are woven, fibrous, or porous in nature and tend to adsorb
- 5 chemicals off-gassed by Type A finishes or may be adversely affected by particulates. These materials become
- 6 "sink" for deleterious substances which may be released much later, or collectors of contaminants that may
- 7 promote subsequent bacterial growth. Including, but not limited to:
- 8
- 9 1. Carpeting and padding.
- 10 2. Fabric wallcovering.
- 11 3. Insulation exposed to airstream.
- 12 4. Acoustic ceiling materials.
- 13 5. Fabric covered acoustic wall panels.
- 14 6. Upholstered furnishings
- 15 7. Materials that can be categorized as both Type A and Type B

- 16 U. Ventilation: The process of supplying and removing air to and from interior spaces by natural or mechanical means.
- 17 V. Volatile organic compounds (VOCs): Chemical compounds based on carbon and hydrogen structures that are
- 18 vaporized at room temperatures. VOCs are one type of indoor air contaminant.
- 19 W. Waste Materials: Large and small pieces of materials indicated which are excess to contract requirements and
- 20 generally include materials salvaged from existing construction and items of trimmings, cuttings, and damaged
- 21 goods resulting from new installations which cannot be effectively used in Work.
- 22 X. LEED Project Administrator: LEED Certified Professional hired by the project owner to review LEED submittals.

- 23 1.4 PREINSTALLATION MEETINGS
- 24 A. Preinstallation Conference: Conduct conference at Project site. Review LEED requirements and action plans for
- 25 complying with requirements. Preinstallation meeting to coincide with regularly scheduled progress meeting.

- 26 1.5 ADMINISTRATIVE REQUIREMENTS
- 27 A. Respond to questions and requests from Architect and USGBC about LEED prerequisites and credits that are the
- 28 responsibility of the Contractor, that depend on product selection or product qualities, or that depend on
- 29 Contractor's procedures until USGBC has made its determination on Project's LEED certification application.
- 30 Document responses as informational submittals.

- 31 1.6 ACTION SUBMITTALS
- 32 A. General: Submit additional sustainable design submittals required by other Specification Sections.
- 33 B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with
- 34 other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED
- 35 requirements.
- 36 C. LEED Submittals: Submit LEED related information under a separate Tab within each product submittal. The LEED
- 37 submittal shall include:
- 38
- 39 1. Summary Sheet: A summary, on General Contractors letterhead, of all LEED information requested in
- 40 specifications shall include:
- 41 a. Project name.

- 1 b. LEED Submittal List: A list of all materials being submitted. For products composed of multiple
2 materials the submittal shall include a list of all materials composing the product.
- 3 c. For Products in Divisions 2 - 10, include the following information:
- 4 1) Material costs, for each material on the LEED submittal list, excluding labor costs, delivery
5 44 cost, cost of installation, as well as profit and overhead.
- 6 2) The preconsumer and post-consumer recycled content of each material on the LEED
7 submittal list.
- 8 3) List of all material manufacturing locations.
- 9 4) Provide distance between manufacturing and construction site.
- 10 d. All other LEED information required inspecification.
- 11 2. Manufacturer's literature with information highlighted that confirm the figures used in the summary report.
- 12 a. If a range is used in the manufacturer's literature, the summary report shall use the lowest 53
13 number in the range
- 14 b. For VOC Submissions: Submit MSDS sheets or manufacturer's literature with VOC figure highlighted.
- 15 D. Project Material Costs Data: Provide a statement, on Contractor's letterhead, documenting the total material for
16 the project. Include a spreadsheet tallying the material cost for all materials specified in Divisions 2 - 32. The total in
17 the material cost data will be used in the LEED Online template to be completed by the Contractor as the 2 actual
18 material cost of the project.
- 19 E. Sustainable Design Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to
20 Proceed containing:
- 21
- 22 1. Example spreadsheets for each construction credit identified in this section.
- 23 2. Contact information for Contractor's LEED coordinators.
- 24 3. Brief description of how the following requirements will be met.
- 25 a. Credit SS Prerequisite 1: Construction Activities Pollution Prevention complying with Section 31 25 8
26 00, Erosion Control.
- 27 b. Credit MR c2: Construction Waste Management complying with Section 01 74 19 Construction
28 Waste Management and Disposal. Include a sample spreadsheet showing how the tipping
29 information is going to be recorded to comply with LEED requirements.
- 30 c. Credit MR c4: Recycled content information including methods of collection and recording. : Include
31 list of proposed materials with recycled content. Indicate cost, post- consumer recycled content,
32 and pre-consumer recycled content for each product having recycled content.
- 33 d. Credit MR c5: Manufacturing location information including methods of collection and recording.
34 Include list of proposed regional materials. Identify each regional material, including its source, cost,
35 and the fraction by weight that is considered regional.
- 36 e. Credit EQ 3.1: Construction indoor-air-quality management plan.
- 37 f. Credit EQ 3.2: Construction indoor-air-quality management plan.
- 38 g. Credit EQ c4.1 – 4.3: VOC information including methods of collection and recording required LEED
39 information.
- 40 4. After CCM approval of the Preliminary Action Plan the Contractor shall update the plan monthly with LEED
41 information collected to date and be submitted as part of a monthly progress report.
- 42 F. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports comparing
43 actual construction and purchasing activities with LEED action plans for the following:
- 44
- 45 1. Credit SS Prerequisite 1: Construction Activities Pollution Prevention.
- 46 2. Credit MR c2: Construction Waste Management. Waste reduction progress reports complying with Section
47 01 74 19 "Construction Waste Management and Disposal."
- 48 3. Credit MR c4: Recycled content for materials specified in Divisions 2 – 32.
- 49 4. Credit MR c5 Regional Materials: Distance to manufacturing for materials specified in Divisions 2 - 32.
- 50 5. IEQ c4.1 – 4.3: VOC information.
- 51 G. Sustainable Design Documentation Submittals:
- 52

- 1 1. The Contractor shall be responsible for completing the following LEED submissions using the LEED online
2 tool for credit submission to USGBC. The LEED Project Administrator will determine if the information
3 prepared by the Contractor is satisfactory for USGBC submission.
- 4 a. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to
5 provide continuous metering of building energy-consumption performance over a period of time of
6 not less than one year of post-construction occupancy.
 - 7 b. Prerequisite SS 1: Provide narrative of erosion control measures followed on project, including
8 compliance with design documents and any deviations necessary to comply with design standards.
9 Provide four photographs at three different times during the construction period for A/E to include
10 with LEED documentation.
 - 11 c. Credit WE 3: Documentation indicating compliance with requirements. In addition to product data,
12 provide flush rate in gallons per flush (gpf) or flow rate in gallons per minute (gpm).
 - 13 d. Credit MR 2. Comply with Division 01 Section "Construction Waste Management and Disposal."
 - 14 e. Credit MR 4: Product data for regional materials indicating location and distance from Project of
15 material manufacturer and point of extraction, harvest, or recovery for each raw material. Include
16 statement indicating cost for each regional material and the fraction by weight that is considered
17 regional.
 - 18 f. Credit MR 5: Product data and certification letter indicating percentages by weight of post-
19 consumer and pre-consumer recycled content for products having recycled content. Include
20 statement indicating costs for each product having recycled content.
 - 21 g. Credit EQ 3.1:
 - 22 1) Construction indoor-air-quality management plan.
 - 23 2) Product data for temporary filtration media.
 - 24 3) Product data for filtration media used during occupancy.
 - 25 4) Construction Documentation: Six photographs at three different times during the
26 construction period, along with a brief description of the SMACNA approach employed,
27 documenting implementation of the indoor-air-quality management measures, such as
28 protection of ducts and on-site stored or installed absorptive materials.
 - 29 h. Credit IEQ 3.2: Construction IAQ Plan: Before Occupancy.
 - 30 1) Signed statement describing the building air flush-out procedures including the dates when
31 flush-out was begun and completed and statement that filtration media was replaced after
32 flush-out.
 - 33 2) Report from testing and inspecting agency indicating results of indoor-air- quality testing
34 and documentation showing compliance with indoor-air-quality testing procedures and
35 requirements.
 - 36 i. Credit EQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system
37 indicating VOC content of each product used. Indicate VOC content in g/L calculated according to
38 40 CFR 59, Subpart D (EPA Method 24).
 - 39 j. Credit EQ 4.2: Product data for paints and coatings used inside the weatherproofing system
40 indicating VOC content of each product used. Indicate VOC content in g/L calculated according to
41 40 CFR 59, Subpart D (EPA Method 24).
 - 42 k. Credit EQ 4.3: Product data and MSDS sheets for each carpet which indicate the adhesives, cushion,
43 and Green Label Plus certificates.

44 1.7 INFORMATIONAL SUBMITTALS

- 45 A. Qualification Data: For LEED coordinator.
- 46 B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude
47 labor, overhead, and profit. Include breakout of costs for the following categories of items:
 - 48 1. Plumbing.
 - 49 2. Mechanical.
 - 50 3. Electrical.
 - 51 4. Specialty items such as elevators and equipment.

- 1 1.8 QUALITY ASSURANCE
- 2 A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED
3 coordinator may also serve as waste management coordinator.
- 4 B. LEED 2009 for New Construction and Major Renovations: Lead Contractor to have a copy of the LEED Reference
5 Manual available on site.
- 6 C. Completion of LEED Documentation: Contractor is required to provide information and back up as needed to
7 complete LEED Design and Construction submittals. Contractor must be available and able to react to USGBC
8 review comments in a timely fashion for any credits that require additional follow up from formal reviews.
- 9 D. Multiple Contractors: Each prime contractor is responsible for adhering to Credit EQ 4.1 and 4.2 for adhesives,
10 sealants, paints and coatings used on the project. Each contractor is responsible for providing required LEED
11 documentation.

12 1.9 CONTRACTOR RESPONSIBILITIES

- 13 A. This project has been registered with USGBC. The Contractor shall provide all necessary documentation for LEED
14 2009 certification in accordance with the specifications. Format and content of all construction documentation
15 must be in accordance with the LEED Reference Guide requirements for supporting data required in event of USGBC
16 audit of the particular credit. Contractor is required to coordinate all requirements to assure assembled data is
17 acceptable to USGBC and respond to USGBC requests for additional construction data in the course of preparing the
18 project for certification.

19 PART 2 - PRODUCTS

20 2.1 MATERIALS, GENERAL

- 21 A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections
22 may specify some requirements that contribute to these LEED credits, Contractor shall provide additional materials
23 and procedures necessary to obtain LEED credits indicated.

24 2.2 REGIONAL MATERIALS

- 25 A. Credit MR 4: Not less than 20 percent of building materials (by cost) shall be regional materials.

26 2.3 RECYCLED CONTENT OF MATERIALS

- 27 A. Credit MR 5: Building materials shall have recycled content such that postconsumer recycled content plus one-half
28 of preconsumer recycled content for Project constitutes a minimum of 20 percent of cost of materials used for
29 Project.

- 30 1. Cost of postconsumer recycled content plus one-half of preconsumer recycled content of an item shall be
31 determined by dividing weight of postconsumer recycled content plus one-half of preconsumer recycled
32 content in the item by total weight of the item and multiplying by cost of the item.
- 33 2. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators and
34 equipment in the calculation.
- 35 3. At a minimum, the materials in the following list must contain the minimum recycled content indicated:
36

Category	Minimum Recycled Content
Compost/mulch	100% post-consumer

Asphaltic Concrete Paving	25% post-consumer
Cast-in-Place Concrete	6% pre-consumer
CMU: Gray Block	20% pre-consumer
Steel Reinforcing Bars	90% combined
Structural Steel Shapes	90% combined
Steel Joists	75% combined
Steel Deck	75% combined
Steel Fabrications	60% combined
Steel Studs	30% combined
Steel Roofing	30% post-consumer
Aluminum Fabrications	35% combined
Rigid Insulation	20% pre-consumer
Batt insulation	30% combined
Cellulose Insulation	90% combined
Rock Wool Insulation	75% pre-consumer
Fireproofing	20% combined
Steel Doors and Frames	35% combined
Gypsum Wallboard	95% combined
Carpet	40% combined
Ceramic Tile Flooring	60% combined
Rubber Flooring and Base	60% combined
Acoustical Ceiling Tile (ACT)	40% post-consumer
ACT Suspension System	90% post-consumer
Toilet Partitions	60% post-consumer

1 2.4 LOW-EMITTING MATERIALS

2 A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, adhesives and sealants shall
3 comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

- 4 1. Wood Glues: 30 g/L.
- 5 2. Metal-to-Metal Adhesives: 30 g/L.
- 6 3. Adhesives for Porous Materials (except Wood): 50 g/L.
- 7 4. Subfloor Adhesives: 50 g/L.
- 8 5. Plastic Foam Adhesives: 50 g/L.
- 9 6. Carpet Adhesives: 50 g/L.
- 10 7. Carpet Pad Adhesives: 50 g/L.
- 11 8. VCT and Asphalt Tile Adhesives: 50 g/L.
- 12 9. Cove Base Adhesives: 50 g/L.
- 13 10. Gypsum Board and Panel Adhesives: 50 g/L.
- 14 11. Rubber Floor Adhesives: 60 g/L.
- 15 12. Ceramic Tile Adhesives: 65 g/L.
- 16 13. Multipurpose Construction Adhesives: 70 g/L.
- 17 14. Fiberglass Adhesives: 80 g/L.
- 18 15. Contact Adhesive: 80 g/L.
- 19 16. Structural Glazing Adhesives: 100 g/L.
- 20 17. Wood Flooring Adhesive: 100 g/L.
- 21 18. Structural Wood Member Adhesive: 140 g/L.
- 22 19. Single-Ply Roof Membrane Adhesive: 250 g/L.
- 23 20. Special-Purpose Contact Adhesive (Contact Adhesive That Is Used to Bond Melamine-Covered Board, Metal,
24 Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
- 25 21. Top and Trim Adhesive: 250 g/L.
- 26 22. Plastic Cement Welding Compounds: 250 g/L.
- 27 23. ABS Welding Compounds: 325 g/L.
- 28 24. CPVC Welding Compounds: 490 g/L.
- 29 25. PVC Welding Compounds: 510 g/L.
- 30 26. Adhesive Primer for Plastic: 550 g/L.

- 1 27. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
 - 2 28. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
 - 3 29. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
 - 4 30. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
 - 5 31. Other Adhesives: 250 g/L.
 - 6 32. Architectural Sealants: 250 g/L.
 - 7 33. Nonmembrane Roof Sealants: 300 g/L.
 - 8 34. Single-Ply Roof Membrane Sealants: 450 g/L.
 - 9 35. Other Sealants: 420 g/L.
 - 10 36. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 11 37. Sealant Primers for Porous Substrates: 775 g/L.
 - 12 38. Modified Bituminous Sealant Primers: 500 g/L.
 - 13 39. Other Sealant Primers: 750 g/L.
- 14 B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply
15 with VOC content limits of authorities having jurisdiction and the following VOC content limits:
- 16 1. Flat Paints and Coatings: VOC not more than 50 g/L.
 - 17 2. Nonflat Paints and Coatings: VOC not more than 150 g/L.
 - 18 3. Dry-Fog Coatings: VOC not more than 400 g/L.
 - 19 4. Primers, Sealers, and Undercoaters: VOC not more than 200 g/L.
 - 20 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 - 21 6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
 - 22 7. Pretreatment Wash Primers: VOC not more than 420 g/L.
 - 23 8. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
 - 24 9. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
 - 25 10. Floor Coatings: VOC not more than 100 g/L.
 - 26 11. Shellacs, Clear: VOC not more than 730 g/L.
 - 27 12. Shellacs, Pigmented: VOC not more than 550 g/L.
 - 28 13. Stains: VOC not more than 250 g/L.
- 29 C. Credit IEQc4.3: All flooring must comply with the following as applicable to the project scope:
30
- 31 1. All carpet and carpet cushion must meet the requirements of the Carpet and Rug Institute Green Label
32 Program.
 - 33 2. All carpet adhesive must have VOC limit of 50 g/L.
 - 34 3. All hard surface flooring must meet the requirements of the Floor Score Standard.
 - 35 4. Concrete, wood, bamboo and cork floor finishes and tile setting adhesives must meet the requirements of
36 South Coast Air Quality Management District (SCAQMD) Rules 1113 and 42 1168.

37 PART 3 - EXECUTION

38 3.1 NONSMOKING BUILDING

- 39 A. Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air
40 intakes.

41 3.2 CONSTRUCTION ACTIVITIES POLLUTION PREVENTION

- 42 A. SS Prerequisite 1 Construction Activities Pollution Prevention:

- 43 1. Follow LEED instructions in LEED NCv3.0 Reference Guide and complying with Section 31 25 00, Erosion
44 Control.
45

- 1 2. Contractor is responsible for completing the LEED online credit template and attaching the following
2 information to the template:
3 a. Provide record of compliance with Erosion and Sediment Control Plan:
4 1) Monthly photographs of barriers and containment.
5 2) Monthly photographs of dust control measures.
6 3) Records of inspections by agency in charge of overseeing compliance.
7 3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
8 for USGBC submission.

9 3.3 CONSTRUCTION WASTE MANAGEMENT

10 A. Credit MRc2: Comply with Division 1 Section "Construction Waste Management and Disposal".

- 11
12 1. Contractor is responsible for completing the LEED online credit template. Attached documentation in
13 support of the credit shall include:
14 a. Monthly photographs of waste recycling sorting area including:
15 1) Debris control fencing.
16 2) Signage clearly identifying the containers content.
17 b. Spreadsheet containing the following information.
18 1) Diverted materials description.
19 2) Diverted materials/waste hauler name.
20 3) Date of each haul.
21 4) Quantity of material in each haul.
22 c. Copies of recycling vender and waste hauler tipping receipts.
23 2. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
24 for USGBC submission.

25 3.4 RECYCLED CONTENT OF BUILDINGMATERIALS

26 A. Credit MRc4: Recycled Content:

- 27
28 1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
29 2. Provide record showing the preconsumer and post-consumer recycled content of all materials specified in
30 34 Divisions 2 -32.
31 3. Contractor is responsible for completing the LEED online credit template and attaching the following
32 information to the template:
33 a. Spreadsheet containing the following information:
34 1) The description of each materials in each product specified in Divisions 2 - 32.
35 2) Material manufacturer's name.
36 3) Material cost.
37 4) Percent preconsumer recycled content of each material.
38 5) Percent post-consumer recycled content of each material.
39 6) Recycled content information source.
40 b. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the
41 figures used in the spreadsheet.
42 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
43 for USGBC submission.

44 3.5 REGIONAL MATERIALS

45 A. Credit MRc5: Regional Materials:

- 46
47 1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
48 2. Provide record showing the manufacturing location for all materials specified in Divisions 2 - 32.

- 1 3. Contractor is responsible for completing the LEED online credit application and attaching the following
2 information to the application:
3 a. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the
4 figures used in the spreadsheet.
5 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
6 for USGBC submission.

7 3.6 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

8 A. Credit IEQc3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
9

- 10 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period
11 as specified in Division 1 Section "Temporary Facilities and Controls", install filter media having a MERV 8
12 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
13 2. Replace all air filters immediately prior to occupancy.
14 3. Provide record of compliance with Indoor Air Quality Management Plan:
15 a. Monthly photographs of equipment and ductwork protection.
16 b. Monthly photographs of filters used to protect air distribution and equipment.
17 c. Contractor's report documenting that MERV 8 filters were used to protect equipment during
18 construction and MERV 13 filters were installed prior to occupancy.

19 B. Credit IEQc3.2: Indoor Air Quality management Plan – Before Occupancy:
20

- 21 1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-
22 out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an
23 internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
24 2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a
25 minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall
26 be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate
27 determined in IEQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation
28 shall begin a minimum of three (3) hours prior to occupancy and continue during occupancy. These
29 conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the
30 space.
31 3. Air-Quality Testing: If the Contractor chooses to test for compliance with LEED Credit IEQc3.2 the following
32 is required:
33 a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using
34 testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air
35 Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and
36 Construction Reference Guide".
37 b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
38 1) Formaldehyde: 27 ppb.
39 2) Particulates (PM10): 50 micrograms/cu. m.
40 3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
41 4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
42 5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
43 c. For each sampling point where the maximum concentration limits are exceeded, conduct additional
44 flush-out with outside air and retest the specific parameter(s) exceeded to indicate the
45 requirements are achieved. Repeat procedure until all requirements have been met. When retesting
46 non-complying building areas, samples are to be taken from the same locations as the first test
47 d. Air-sample testing shall be conducted as follows:
48 1) All measurements shall be conducted prior to occupancy but during normal occupied hours
49 and with building ventilation system starting at the normal daily start time and operated at
50 the minimum outside air flow rate for the occupied mode throughout the duration of the air
51 testing.
52 2) Building shall have all interior finishes installed including, but not limited to, millwork, doors,
53 paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and partitions
54 are encouraged, but not required to be in place for the testing.

- 1 3) Number of sampling locations will vary depending on the size of building and number of
2 ventilation systems. For each portion of building served by a separate ventilation system,
3 the number of sampling points shall not be less than one per 25,000 sq. ft. or for each
4 contiguous floor area, whichever is larger, and shall include areas with the least ventilation
5 and greatest presumed source strength.
6 4) Air samples shall be collected between 3 and 6 feet from the floor to represent the
7 breathing zone of occupants, and over a minimum four- hour period.
8 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
9 for USGBC submission.

10 3.7 LOW EMITTING MATERIALS

- 11 A. Credit IEQc4.1 through Credit MRc4.3: Low Emitting Materials:
12
13 1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
14 2. Contractor is responsible for completing the LEED online credit template and attaching the following
15 information to the template:
16 a. Copies of vendor’s literature or MSDS sheets confirming the figures used in the spreadsheet.
17 3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory
18 for USGBC submission.

19 3.8 INDOOR CHAMICAL AND POLLUTANT SOURCE CONTROL

- 20 A. Credit IEQc5: Indoor Chemical and Pollutant Source Control:
21
22 1. Install new air filtration media, with a MERV 13 Rating, in regularly occupied areas prior to occupancy.

23 3.9 SUPPLEMENT

- 24 A. The supplement listed below, following “End of Section,” is a part of this Specification:
25
26 1. LEED for New Construction v3.0 Registered Project Checklist.

27 3.10 REFRIGERANT AND CLEAN-AGENT FIRE-EXTINGUISHING-AGENT REMOVAL

- 28 A. Prerequisite EA 3: Remove CFC-based refrigerants according to Section 024116 "Structural Demolition" from
29 existing HVAC&R equipment.

30 3.11 MEASUREMENT AND VERIFICATION

- 31 A. Credit EA 5: Implement measurement and verification plan consistent with Specification Section 01 95 00
32 Measurement and Verification.

33
34
35
36
37

1

LEED SUBMITTAL SAMPLE FORM

2

PART 4 - MR Credit 4: Regional Materials.

3

Manufacturer	Product	Material Cost	Distance Between Project and Extraction /Harvest Site (in miles)	Distance Between Project and Manufacturer (in miles)	VOC Content if Applicable
Subtotal					

Name _____

Company _____

Role in Project _____

Signature _____

Date _____

4

5

A. _____ Product data and MSDS sheets have been attached for all adhesives, sealants, paints & coatings as specified in section 01 81 13.

6

7

8

1 PART 5 - MR Credit 5: Recycled Content

2

Manufacturer	Product	Material Cost	Pre-consumer Recycled Content	Post-Consumer Recycled Content	VOC Content if Applicable
Subtotal					

Name _____

Company _____

Role in Project _____

Signature _____

Date _____

3

4 A. _____ Product data and MSDS sheets have been attached for all adhesives, sealants, paints & coatings
 5 as specified in section 01 81 13.

6

7 END OF SECTION 018113.13

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LEED 2009 for New Construction and Major Renovations

Project Checklist

Police Department Midtown District

Date 4/28/17

16	0	10
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Sustainable Sites Possible Points: 26

Y ? N d/C

Y	?	N	d/C	Description	Points
Y			C	Prereq 1 Construction Activity Pollution Prevention	
1			d	Credit 1 Site Selection	1
5			d	Credit 2 Development Density and Community Connectivity	5
		1	d	Credit 3 Brownfield Redevelopment	1
6			d	Credit 4.1 Alternative Transportation—Public Transportation Access	6
1			d	Credit 4.2 Alternative Transportation—Bicycle Storage and Changing Rooms	1
		3	d	Credit 4.3 Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
		2	d	Credit 4.4 Alternative Transportation—Parking Capacity	2
		1	C	Credit 5.1 Site Development—Protect or Restore Habitat	1
		1	d	Credit 5.2 Site Development—Maximize Open Space	1
1			d	Credit 6.1 Stormwater Design—Quantity Control	1
		1	d	Credit 6.2 Stormwater Design—Quality Control	1
1			C	Credit 7.1 Heat Island Effect—Non-roof	1
		1	d	Credit 7.2 Heat Island Effect—Roof	1
1			d	Credit 8 Light Pollution Reduction	1

Notes:

6	0	4
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Water Efficiency Possible Points: 10

Y ? N

Y	?	N	d/C	Description	Points
Y			d	Prereq 1 Water Use Reduction—20% Reduction	
4			d	Credit 1 Water Efficient Landscaping	2 to 4
				Reduce by 50%	2
				x No Potable Water Use or Irrigation	4
		2	d	Credit 2 Innovative Wastewater Technologies	2
2		2	d	Credit 3 Water Use Reduction	2 to 4
				X Reduce by 30%	2
				Reduce by 35%	3
				Reduce by 40%	4

Notes:

20	2	13
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Energy and Atmosphere Possible Points: **35**

Y	?	N
Y		
Y		
Y		
10	1	8

C	Prereq 1	Fundamental Commissioning of Building Energy Systems		
d	Prereq 2	Minimum Energy Performance		
d	Prereq 3	Fundamental Refrigerant Management		
d	Credit 1	Optimize Energy Performance	1 to 19	
		<input type="checkbox"/> Improve by 12% for New Buildings or 8% for Existing Building Renovations	1	
		<input type="checkbox"/> Improve by 14% for New Buildings or 10% for Existing Building Renovations	2	
		<input type="checkbox"/> Improve by 16% for New Buildings or 12% for Existing Building Renovations	3	
		<input type="checkbox"/> Improve by 18% for New Buildings or 14% for Existing Building Renovations	4	
		<input type="checkbox"/> Improve by 20% for New Buildings or 16% for Existing Building Renovations	5	
		<input type="checkbox"/> Improve by 22% for New Buildings or 18% for Existing Building Renovations	6	
		<input type="checkbox"/> Improve by 24% for New Buildings or 20% for Existing Building Renovations	7	
		<input type="checkbox"/> Improve by 26% for New Buildings or 22% for Existing Building Renovations	8	
		<input type="checkbox"/> Improve by 28% for New Buildings or 24% for Existing Building Renovations	9	
		<input checked="" type="checkbox"/> Improve by 30% for New Buildings or 26% for Existing Building Renovations	10	
		<input type="checkbox"/> Improve by 32% for New Buildings or 28% for Existing Building Renovations	11	
		<input type="checkbox"/> Improve by 34% for New Buildings or 30% for Existing Building Renovations	12	
		<input type="checkbox"/> Improve by 36% for New Buildings or 32% for Existing Building Renovations	13	
		<input type="checkbox"/> Improve by 38% for New Buildings or 34% for Existing Building Renovations	14	
		<input type="checkbox"/> Improve by 40% for New Buildings or 36% for Existing Building Renovations	15	
		<input type="checkbox"/> Improve by 42% for New Buildings or 38% for Existing Building Renovations	16	
		<input type="checkbox"/> Improve by 44% for New Buildings or 40% for Existing Building Renovations	17	
		<input type="checkbox"/> Improve by 46% for New Buildings or 42% for Existing Building Renovations	18	
		<input type="checkbox"/> Improve by 48%+ for New Buildings or 44%+ for Existing Building Renovation:	19	
	d	Credit 2	On-Site Renewable Energy	1 to 7
			<input type="checkbox"/> 1% Renewable Energy	1
			<input type="checkbox"/> 3% Renewable Energy	2
			<input checked="" type="checkbox"/> 5% Renewable Energy	3
			<input type="checkbox"/> 7% Renewable Energy	4
			<input type="checkbox"/> 9% Renewable Energy	5
			<input type="checkbox"/> 11% Renewable Energy	6
			<input type="checkbox"/> 13% Renewable Energy	7
	C	Credit 3	Enhanced Commissioning	2
	d	Credit 4	Enhanced Refrigerant Management	2
	C	Credit 5	Measurement and Verification	3
	C	Credit 6	Green Power	2

3	1	3
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2		
2		
3		
		2

Notes:

4	2	8
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Materials and Resources

Possible Points: 14

Y	?	N
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Y		
		3

- d Prereq 1 Storage and Collection of Recyclables
- C Credit 1.1 Building Reuse—Maintain Existing Walls, Floors, and Roof 1 to 3
 - Reuse 55% 1
 - Reuse 75% 2
 - Reuse 95% 3
- C Credit 1.2 Building Reuse—Maintain 50% of Interior Non-Structural Elements 1
- C Credit 2 Construction Waste Management 1 to 2
 - 50% Recycled or Salvaged 1
 - 75% Recycled or Salvaged 2
- C Credit 3 Materials Reuse 1 to 2
 - Reuse 5% 1
 - Reuse 10% 2
- C Credit 4 Recycled Content 1 to 2
 - 10% of Content 1
 - 20% of Content 2
- C Credit 5 Regional Materials 1 to 2
 - 10% of Materials 1
 - 20% of Materials 2
- C Credit 6 Rapidly Renewable Materials 1
- C Credit 7 Certified Wood 1

Notes:

11	0	4
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Indoor Environmental Quality

Possible Points: 15

Y	?	N
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Y		
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1		
---	--	--

- d Prereq 1 Minimum Indoor Air Quality Performance
- d Prereq 2 Environmental Tobacco Smoke (ETS) Control
- d Credit 1 Outdoor Air Delivery Monitoring 1
- d Credit 2 Increased Ventilation 1
- C Credit 3.1 Construction IAQ Management Plan—During Construction 1
- C Credit 3.2 Construction IAQ Management Plan—Before Occupancy 1
- C Credit 4.1 Low-Emitting Materials—Adhesives and Sealants 1
- C Credit 4.2 Low-Emitting Materials—Paints and Coatings 1
- C Credit 4.3 Low-Emitting Materials—Flooring Systems 1
- C Credit 4.4 Low-Emitting Materials—Composite Wood and Agrifiber Products 1
- d Credit 5 Indoor Chemical and Pollutant Source Control 1
- d Credit 6.1 Controllability of Systems—Lighting 1
- d Credit 6.2 Controllability of Systems—Thermal Comfort 1
- d Credit 7.1 Thermal Comfort—Design 1
- d Credit 7.2 Thermal Comfort—Verification 1
- d Credit 8.1 Daylight and Views—Daylight 1
- d Credit 8.2 Daylight and Views—Views 1

Notes:

1	0	5
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Innovation and Design Process**Possible Points: 6**

Y	?	N
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Y	?	N			
		1	d/C Credit 1.1	Innovation in Design: Specific Title	1
		1	d/C Credit 1.2	Innovation in Design: Specific Title	1
		1	d/C Credit 1.3	Innovation in Design: Specific Title	1
		1	d/C Credit 1.4	Innovation in Design: Specific Title	1
		1	d/C Credit 1.5	Innovation in Design: Specific Title	1
1			d/C Credit 2	LEED Accredited Professional	1

Notes:

4	0	0
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Regional Priority Credits**Possible Points: 4**

Y	?	N
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Y	?	N			
1			d/C Credit 1.1	Regional Priority: Stormwater design - quantity control	1
1			d/C Credit 1.2	Regional Priority: Alternate Transportation: Bike storage and shower	1
1			d/C Credit 1.3	Regional Priority: WEC3 30%	1
1			d/C Credit 1.4	Regional Priority: SSc2	1

Notes:

62	4	44
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Total**Possible Points: 110**

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

**SECTION 01 91 00
COMMISSIONING (CX) PROCESS**

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PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes specifications for the implementation, tracking and verification of the commissioning process.

1.2 RELATED SPECIFICATIONS

- A. 01 31 13 Project Management and Coordination
B. 01 31 19 Project Meetings
C. 01 31 23 Project Management
D. 01 32 26 Construction Progress Reporting
E. 01 33 23 Submittals
F. 01 45 16 Field Quality Control
G. 01 77 00 Closeout Procedures
H. 01 78 23 Operation and Maintenance Data
I. 01 78 39 As-Built Drawings
J. 01 79 00 Demonstration and Training
K. 01 91 10 Commissioning (Cx) Construction Checklists
L. 01 91 20 Commissioning (Cx) Functional Performance Testing
M. 01 81 13.13 Sustainable Design Requirements
N. 23 05 93 Testing, Adjusting, and Balancing for HVAC
O. 23 09 00 Instrumentation and Control for HVAC
P. 23 09 23 Direct Digital Control (DDC) System for HVAC
Q. 23 09 93.11 Sequence of Operations for HVAC DDC

1 **1.3 REFERENCES**

- 2 A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
3 B. ASHRAE Guideline 0-2005, "The Commissioning Process".
4 C. NEBB – Procedural Standards for Building Systems Commissioning.
5

6 **1.4 DEFINITIONS**

- 7 A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests are
8 performed.
9 B. Commissioning Authority (CxA) - an independent entity, not otherwise associated with the A/E team members or
10 the Contractor and reporting directly to the Owner. The CxA directs and coordinates the commissioning activities.
11 C. Commissioning Plan (Cx Plan) - an overall plan, developed before or after bidding, that provides the structure,
12 schedule and coordination planning for the commissioning process.
13 D. Contract Documents - the documents binding on parties involved in the construction of this project (drawings,
14 specifications, change orders, amendments, contracts, Cx Plan, etc.).
15 E. Construction Checklist (CC) - a list of items to verify and test equipment and components to verify proper
16 installation of equipment. The CCs are provided by the CxA to the Contractor(s).
17 F. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers
18 separate from the control system.
19 G. Deferred Functional Performance Tests - FPT's that are performed later, after substantial completion, due to partial
20 occupancy, equipment, seasonal requirements, design or other site conditions that prevent the tests from being
21 performed earlier.
22 H. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative
23 present.
24 I. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting
25 a damper to be 100% closed.
26 J. Issue - a condition in the installation or function of a component, piece of equipment or system that is not in
27 compliance with the Contract Documents (that is, does not perform properly or is not complying with the Owner's
28 Project Requirements).
29 K. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify
30 performance (contrasted to analyzing monitored data taken over time to make the "observation").
31 L. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using
32 dataloggers or the trending capabilities of control systems.
33 M. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g.,
34 changing the outside air temperature value from 75F to 50F to verify economizer operation). See also "Simulated
35 Signal."
36 N. Owner's Project Requirements (OPR) - A document that describes what the Owner and stakeholders want to
37 achieve with this project and what expectations they have of the completed project.
38 O. Sampling - reviewing or testing only a fraction of the total number of identical or near identical pieces of
39 equipment.
40 P. Seasonal Performance Tests - SPT's that are deferred until the system(s) will experience conditions closer to their
41 design conditions.
42 Q. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a
43 hair blower to a space sensor to see the response in a VAV box).
44 R. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure
45 to the transducer and DDC system to simulate a sensor value.
46 S. Functional Performance Test (FPT) - Dynamic testing of entire systems (rather than just components of the system)
47 under full operation.
48 T. Trending - monitoring using the building automation system.
49

50 **1.5 DESCRIPTION**

- 51 A. Commissioning (Cx) is a systematic process of verifying that all building systems perform interactively to meet the
52 Owner's Project Requirements (OPR). This is achieved by beginning in the planning phase and continuing through
53 design, construction, acceptance, and the warranty period with verification of performance.
54 B. The Cx process does not take away from or reduce the responsibility of the system designers or installing contractors
55 to provide a finished and fully functioning product.
56 C. The commissioning authority (CxA) has no authority to change, modify or direct any work. The CxA can only provide
57 comments and suggestions.

- 1 D. Commissioning Plan. The Cx Plan provides guidance in the execution of the Cx process. The CxA will update the Cx
2 Plan regularly as the project progresses. The Drawings and Specifications will take precedence over the Cx Plan.
3

4 **1.6 COMMUNICATION**

- 5 A. Communication resulting from or in relation to commissioning activities will be relayed directly to the responsible
6 party whenever possible, with copies to the Owner, A/E and Contractor.
7

8 **1.7 COMMISSIONED SYSTEMS**

- 9 A. Commissioned systems are defined as the equipment and/or systems pertaining to the systems or equipment listed
10 below:
11 1. Air-handling Units
12 2. Energy Recovery Units
13 3. Toilet, Kitchen, and General Exhaust
14 4. Terminal Units
15 5. Domestic Hot Water Systems and Associated Pumps
16 6. Energy Management & Control Systems (BAS)
17 7. Indoor Lighting and Control Systems
18 8. Outdoor Lighting and Control Systems
19 9. Energy Metering
20 10. Boilers and Associated Pumps
21 11. Water Softeners
22 12. Refrigerant Piping and Systems
23 13. AC Units
24 14. Ductwork
25 15. Unit and Cabinet Heaters
26 16. Radiant Devices
27 17. Photovoltaics
28

29 **1.8 RESPONSIBILITIES**

- 30 A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities
31 listed for Contractor apply to all contractors related scope as well as any sub-contractors, consultants and/or
32 personnel under the employment of the Contractor.
33 B. All Parties
34 1. Follow the Commissioning Plan.
35 2. Attend commissioning meetings, as necessary.
36 C. Architect
37 1. Review and approve submittals, O&M data, training program and as-builts in accordance with contracted
38 services.
39 2. Provide design narrative documentation as requested by the CxA. This includes clarifying the operation and
40 control of commissioned equipment in areas where the specifications, control drawings or equipment
41 documentation is not sufficient for writing detailed testing procedures.
42 3. Attend the commissioning meetings as requested.
43 4. Review TAB plan and report.
44 5. Coordinate resolution of system deficiencies and discrepancies identified during commissioning, according to the
45 contract documents.
46 6. Prepare and submit final as-built basis of design and owner project requirements documentation for inclusion in
47 the O&M data.
48 7. Prepare and submit final as-built one line system diagrams and narratives for inclusion in the O&M data.
49 8. Coordinate resolution of design non-conformance and deficiencies identified during warranty-period
50 commissioning.
51 D. CxA
52 1. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document
53 performance—that systems are functioning in accordance with the documented intention of design and in
54 accordance with the Contract Documents.
55 2. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using
56 consistent protocols and forms, centralized documentation, clear and regular communications and consultations
57 with all necessary parties, frequently updated timelines and schedules and technical expertise.
58 3. Prepare and maintain commissioning plan.

- 1 4. Prepare and update commissioning milestones and schedule.
- 2 5. Coordinate the commissioning work and, with Contractor, verify that commissioned activities are being
- 3 scheduled into the master schedule.
- 4 6. Coordinate and facilitate commissioning meetings as required.
- 5 7. Request and review additional information required to perform commissioning tasks, including O&M data,
- 6 contractor start-up and checkout procedures.
- 7 8. Review normal Contractor submittals applicable to systems being commissioned for compliance with
- 8 commissioning needs, concurrent with the Architect reviews.
- 9 9. Plan and conduct commissioning meetings.
- 10 10. Develop construction checklists and provide Contractor with final construction checklists in approved format
- 11 with accompanying tracking system.
- 12 11. Provide Contractor with training in relation to use of construction checklists and tracking system.
- 13 12. Provide Contractor with access to itemized list detailing construction checklist items requiring action.
- 14 13. Before startup, review the current control sequences and interlocks and work with contractors and Architect
- 15 until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
- 16 14. Perform site visits, as contracted, to observe equipment and system installations.
- 17 15. Attend selected planning and job-site meetings to obtain information on construction progress.
- 18 16. Witness part of the additional testing specified for the commissioned systems, in sufficient detail to be confident
- 19 that proper procedures were followed. Review the reports prepared by the Contractors to document the testing
- 20 procedures. Notify Architect and Owner of any deficiencies in results or procedures.
- 21 17. Review construction checklist completion by reviewing construction checklist completion reports and by selected
- 22 site observation and spot checking. Advise Contractor of status of construction checklist completion and
- 23 discrepancies identified.
- 24 18. Review and witness a sampling of equipment start-up and reports, in sufficient detail to be confident of results
- 25 and procedures followed.
- 26 19. Review a sampling of as-built drawings, in sufficient detail to be confident of validity and accuracy of the
- 27 documentation.
- 28 20. Review TAB plan and report.
- 29 21. Verify air and water systems balancing by spot testing, by reviewing completed reports and by selected site
- 30 observation.
- 31 22. Prepare and provide contractor readiness criteria to Contractor.
- 32 23. Analyze any functional performance trend logs and monitoring data to verify performance.
- 33 24. Witness and document manual functional and seasonal tests performed by installing contractors. Coordinate
- 34 retesting as necessary until satisfactory performance is achieved.
- 35 25. Maintain a master issue and resolution log and a separate testing record. Provide Contractor with written
- 36 progress reports and test results with recommended actions.
- 37 26. Review equipment warranties to verify that the Owner's responsibilities are clearly defined.
- 38 27. Review the training of the Owner's operating personnel per contract.
- 39 28. Compile and maintain a commissioning record.
- 40 29. Review the preparation of the O&M data.
- 41 30. Coordinate and facilitate warranty review with Owner staff and provide formal report of findings to Architect,
- 42 Owner and Contractor.
- 43 E. Contractor
- 44 1. Facilitate the coordination of the commissioning work by the CxA, and with other contractors.
- 45 2. Include the cost of commissioning in the total contract price as it relates to support, coordination and allocation
- 46 of labor and resources to the CxA for the items and responsibilities outlined as contractor responsibilities for the
- 47 commissioning process.
- 48 3. Verify that commissioning activities are being scheduled into the master schedule.
- 49 4. Develop and maintain a detailed MEP startup plan and schedule in accordance with guideline outlined within this
- 50 section, and provide regular updates in coordination with master schedule update to CxA.
- 51 5. Attend commissioning meetings as requested.
- 52 6. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop
- 53 drawings related to commissioned equipment to the CxA.
- 54 7. In each purchase order or subcontract written, include requirements for submittal data, O&M data,
- 55 commissioning tasks and training.
- 56 8. Ensure that all sub-contractors and personnel execute their commissioning responsibilities according to the
- 57 Contract Documents and schedule.

- 1 9. Complete construction checklists for sections responsible for, according to procedures specified under this
- 2 section.
- 3 10. .
- 4 11. Review and approve the functional performance test procedures submitted by CxA.
- 5 12. Provide CxA with contractor readiness notification.
- 6 13. Facilitate and assist CxA as necessary in the functional and seasonal testing of selected equipment and systems.
- 7 14. Ensure sub-contractors and personnel facilitate and assist CxA as necessary in the functional and seasonal testing
- 8 of selected equipment and systems.
- 9 15. Review commissioning progress and issues reports.
- 10 16. Coordinate and facilitate the resolution of non-compliance, deficiencies and discrepancies identified in all phases
- 11 of commissioning.
- 12 17. Ensure sub-contractors and personnel coordinate and facilitate the resolution of non-compliance, deficiencies
- 13 and discrepancies identified in all phases of commissioning.
- 14 18. Coordinate and facilitate the training of Owner personnel.
- 15 19. Prepare O&M data, according to the Contract Documents, including clarifying and updating Contract Documents
- 16 to as-built conditions.
- 17 F. Equipment and Material Supplier
- 18 1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the
- 19 Owner to keep warranties in force.
- 20 2. Assist in equipment testing per agreements with Contractor.
- 21 3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required
- 22 for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for
- 23 stand-alone datalogging equipment that may be used by CxA.
- 24 4. Through the Contractor they supply products to, analyze specified products and verify that the Architect has
- 25 specified the newest most updated equipment reasonable for this project's scope and budget.
- 26 5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
- 27 6. Review and approve test procedures for equipment installed by factory representatives.
- 28

1.9 SUBMITTALS

- A. The following table contains deliverables and/or submittals required under this section, the party(s) responsible for each, the frequency and or timeline these items shall be provided, the format and quantity to be provided, and the party(s) to be provided to.

Submittal	Party(s) Responsible	Frequency or Timeline	Format & Quantity	Party(s) Provided To
Draft commissioning plan	CxA	45 days following commencement of work	Electronic	Contractor, Owner, Architect
Draft construction schedule	Contractor	1 week prior to commencement of work	Electronic	CxA
Detailed MEP installation and start-up schedule and plan	Contractor	1 week prior to commencement of work	Electronic	CxA
Commissioning milestones for construction schedule	CxA	Within 7 days of receipt of schedule	Electronic	Contractor
Updated construction schedule	Contractor	Concurrent with each pay period	Electronic	CxA
Submittal register	Contractor	1 week prior to commencement of work	Electronic	CxA
Submittal log	Contractor	Weekly	Electronic	CxA
Submittals (Commissioned Systems)	Contractor	Concurrent with submissions to A/E	Electronic	CxA

Submittal	Party(s) Responsible	Frequency or Timeline	Format & Quantity	Party(s) Provided To
Notification of equipment and/or system start-up	Contractor	7 days prior to scheduled start-up	Electronic	CxA, Architect
Equipment and/or system start-up reports	Contractor	Within 7 days of start-up	Electronic	CxA, Architect
Notification of specified testing for commissioned systems and procedures (FPT excluded)	Contractor	7 days prior to scheduled test	Electronic	CxA, Architect
Specified testing reports for commissioned systems	Contractor	Within 7 days of testing	Electronic	CxA, Architect
Site visit report	CxA	Within 7 days of site visit	Electronic	Contractor, Architect, Owner
Notification of commissioning meeting and agenda	CxA	7 days prior to meeting	Electronic	Contractor
Commissioning meeting minutes	CxA	Within 7 days of meeting	Electronic	Contractor, Architect, Owner
TAB plan	Contractor	90 days prior to scheduled start date	Electronic	CxA, Architect
TAB plan review comments	CxA	Within 7 days of receipt of plan	Electronic	Architect
TAB report	Contractor	Within 7 days of TAB completion	Electronic	CxA, Architect
Resolution report for commissioning issues	Contractor	Within 7 days of receipt of issues report	Electronic	CxA, Architect, Owner
Warranty review report	CxA	Within 7 days of completion of warranty walkthrough	Electronic	Contractor, Architect, Owner
Warranty resolution report	Contractor	Within 7 days of completion of work	Electronic	CxA, Architect, Owner

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PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout, additional testing and required functional performance testing shall be provided by Contractor for the equipment being tested.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CxA.
- C. Datalogging equipment and software required to test equipment, if used, will be provided by the CxA.
- D. All test equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Contract Documents. Refer to specification section 23 05 93- Testing, Adjusting, and Balancing for required instrument tolerances.

PART 3 - EXECUTION

3.1 COMMISSIONING TEAM

- A. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner’s Project Manager (PM), the designated representative of the Owner’s Construction Management firm (CM), Contractors, the architect and design engineers, subcontractors, and/or suppliers of equipment.
- B. Each Cx Team member shall designate one person who is responsible for coordinating the commissioning efforts with the CxA.

1 **3.2 COMMISSIONING PLAN**

- 2 A. CxA shall develop a complete commissioning plan detailing the following information at a minimum:
- 3 1. Contact information for key members of commissioning team.
- 4 2. Description of procedures to be utilized for each commissioning task.
- 5 3. List of commissioned systems and associated equipment.
- 6 4. Sampling approach to be utilized for each equipment and system type by commissioning task.
- 7 5. List of responsibilities for each party involved in the commissioning process.
- 8 6. Commissioning milestones and schedule.
- 9 7. Record of results for commissioning tasks to date.
- 10 B. CxA shall provide an initial copy of the commissioning plan to Contractor in the format, quantity and timeframe
- 11 defined under SUBMITTALS for this section.

12

13 **3.3 SCHEDULING**

- 14 A. Contractor to provide CxA with updates to construction schedule in the format, quantity and timeframe defined
- 15 under SUBMITTALS for this section.
- 16 B. CxA shall provide Contractor detailed list of commissioning milestones and task schedule for incorporation into
- 17 Contractor master schedule.
- 18 C. Contractor to incorporate all commissioning milestones identified (including predecessors and dependencies) in the
- 19 overall construction schedule and provide updates to all parties in the format, quantity and timeframe defined under
- 20 SUBMITTALS for this section.
- 21 D. Contractor shall develop a detailed MEP start-up plan and schedule for the project in accordance and provide to the
- 22 CxA in the format, quantity and timeframe defined under SUBMITTALS for this section. The MEP start-up plan and
- 23 schedule shall be organized by system and equipment and shall include at a minimum for each system and piece of
- 24 equipment as applicable:
- 25 1. Submittal Issuance Date and required Date for Approval
- 26 2. Delivery Date
- 27 3. Installation/Setting Start and Finish Dates
- 28 4. Ductwork Installation to Unit Start and Finish Dates
- 29 5. Ductwork Installation for Primary Systems Serving or Served by Unit Start and Finish Dates
- 30 6. Ductwork Testing Start and Finish Dates (separate start and finish dates for each test specified)
- 31 a. Provide procedures and proposed report format for each test specified
- 32 7. Piping Installation to Unit Start and Finish Dates (separate start and finish dates for each piping system to unit)
- 33 8. Piping Installation for Primary Systems Serving or Served by Unit Start and Finish Dates (separate start and finish
- 34 dates for each piping system served or serving unit)
- 35 9. Piping Testing Start and Finish Dates (separate start and finish dates for each test specified)
- 36 a. Provide procedures and proposed report format for each test specified
- 37 10. Electrical Installation to Unit Start and Finish Dates
- 38 11. Electrical Installation for Primary Systems Serving or Served by Unit Start and Finish Dates
- 39 12. Date for Application of Permanent Power
- 40 13. Electrical Testing Start and Finish Dates (separate start and finish dates for each test specified)
- 41 a. Provide procedures and proposed report format for each test specified
- 42 14. Controls Installation to Unit Start and Finish Dates
- 43 15. Controls Installation for Primary Systems Serving or Served by Unit Start and Finish Dates
- 44 16. Fire Alarm Installation to Unit Start and Finish Dates
- 45 17. Fire Alarm Installation for Primary Systems Serving or Served by Unit Start and Finish Dates
- 46 18. Security Installation to Unit Start and Finish Dates
- 47 19. Security Installation for Primary Systems Serving or Served by Unit Start and Finish Dates
- 48 20. Unit Start-up and Testing Start and Finish Dates (separate start and finish dates for each start-up/test specified)
- 49 a. Provide procedures and proposed report format for each start-up/test specified
- 50 21. Controls Start-up and Testing Start and Finish Dates (separate start and finish dates for each start-up/test
- 51 specified)
- 52 a. Provide procedures and proposed report format for each start-up/test specified
- 53 22. Fire Alarm Testing Start and Finish Dates (separate start and finish dates for each test specified)
- 54 a. Provide procedures and proposed report format for each test specified
- 55 23. Security Testing Start and Finish Dates (separate start and finish dates for each test specified)
- 56 a. Provide procedures and proposed report format for each test specified
- 57 24. TAB Start and Finish Dates
- 58 25. Date for Issuance of TAB Report

- 1 26. Finalization and Cleanup Start and Finish Dates
- 2 27. Punchlist Start and Finish Dates
- 3 28. FPT Start and Finish Dates
- 4 29. Substantial Completion Date
- 5 E. Contractor to provide notice to CxA in accordance with the format, quantity and timeframe defined under
- 6 SUBMITTALS for this section with regards to the following activities unless specifically stated otherwise within
- 7 another section of the specifications:
- 8 1. Equipment or system start-up.
- 9 2. Specified testing other than FPT.
- 10 3. Cancellation of activity requiring CxA attendance.
- 11

12 **3.4 PRE-CONSTRUCTION COMMISSIONING MEETING**

- 13 A. Contractor and affiliated sub-contractors and personnel associated with work with the commissioned systems of this
- 14 project shall attend pre-construction commissioning meeting facilitated by CxA.
- 15

16 **3.5 SUBMITTAL REVIEWS**

- 17 A. Contractor shall supply one complete copy of the submittal schedule to CxA in accordance with section 013219
- 18 Submittal Schedule.
- 19 B. Upon receipt CxA shall review submittal in accordance with sampling method and rate defined in parallel with
- 20 Architect review and provide comments to the Architect for inclusion in their final comments to Contractor within 7
- 21 days of receipt of submittal.
- 22 C. Architect shall provide CxA with responses to all comments issued by CxA via CxA provided issues management
- 23 system in concurrence with collated comments and action for submittal in accordance with 013323 Submittals
- 24 requirements for submittals.
- 25 D. CxA shall not review any re-submittal provided by Contractor regardless if re-submittal is in reference to comments
- 26 issued by CxA. All re-submittals shall be handled in accordance with 013323 Submittals requirements and process for
- 27 submittals by Architect, and Architect shall be responsible to provide notification and response to CxA upon
- 28 satisfactory closure of applicable comments for submittals and re-submittals.
- 29

30 **3.6 CONSTRUCTION VERIFICATION**

- 31 A. See 019110 Commissioning (Cx) Construction Checklists.
- 32

33 **3.7 START-UP VERIFICATION**

- 34 A. Contractor shall notify CxA and Architect in accordance with the format, quantity and timeframe defined under
- 35 SUBMITTALS for this section.
- 36 B. CxA and Architect shall witness equipment or system start-up as deemed necessary.
- 37 C. Contractor to supply one copy of the start-up report to CxA and Architect in accordance with the format, quantity and
- 38 timeframe defined under SUBMITTALS for this section.
- 39

40 **3.8 TESTING VERIFICATION**

- 41 A. For all commissioned systems, Contractor shall notify CxA and Architect in accordance with the format, quantity and
- 42 timeframe defined under SUBMITTALS for this section for any testing specified under technical section for a given
- 43 equipment or system within the commissioned systems.
- 44 B. CxA and Architect shall witness additional testing as deemed necessary.
- 45 C. Contractor to supply one copy of the test report to CxA and Architect in accordance with the format, quantity and
- 46 timeframe defined under SUBMITTALS for this section.
- 47

48 **3.9 AS-BUILT VERIFICATION**

- 49 A. Contractor shall maintain on site and up to date one copy of project as-builts per the requirements of 017839 As-Built
- 50 Drawings.
- 51 B. As-built drawings maintained by Contractor will be periodically reviewed and verified during construction by CxA.
- 52 Discrepancies in the drawings will be documented in site visit reports and the Contractor shall be responsible to verify
- 53 and correct the as-built drawings against the installed system for specified and all similar problems noted.
- 54

55 **3.10 FIELD OBSERVATIONS**

- 56 A. CxA shall provide Contractor with an outline of field observations detailing the number and dates of anticipated visits
- 57 within the Cx plan described within this section.

- 1 B. Field observations by CxA shall consist of at least one of the following activities, with the actual scope of activities to
2 be clearly defined within the report provided at the conclusion of the visit:
- 3 1. Construction Checklists
 - 4 2. Start-up verification
 - 5 3. Testing verification
 - 6 4. As-built verification
 - 7 5. General review of progress and quality
 - 8 6. Meeting attendance
 - 9 7. Commissioning meeting
 - 10 8. Attendance of Owner training session
- 11 C. Contractor shall ensure that personnel related to activities, areas and systems scheduled for a given visit by CxA re
12 readily available for questions and/or assistance to CxA. CxA will give a minimum of 2 days notice if assistance is
13 anticipated for a given visit.
- 14 D. CxA shall provide Contractor, Architect and Owner with a clear record of the activities performed for the visit and any
15 deficiencies, discrepancies or issues identified in accordance with the format, quantity and timeframe defined under
16 SUBMITTALS for this section. Report shall clearly detail the scope and location of the issues identified, including
17 provision of photographs as possible.
- 18 E. Contractor shall supply CxA with a detailed resolution report via CxA provided issues management system in
19 accordance with the format, quantity and timeframe defined under SUBMITTALS for this section. Responses shall
20 include the following information as applicable:
- 21 1. Method of resolution.
 - 22 2. Date of resolution.
 - 23 3. List of similar installations and areas reviewed and resolved.
 - 24 4. Photo documentation of resolution (ONLY for items inaccessible for verification)
 - 25 5. Reference documentation
- 26

27 3.11 COMMISSIONING MEETINGS

- 28 A. Periodically CxA shall call a meeting of Contractor, Architect and Owner to review progress of the project, review
29 issues, and discuss scheduling for future commissioning tasks.
- 30 B. To the fullest extent possible CxA shall schedule meetings to occur at times that coincide with existing meetings
31 scheduled for Contractor to minimize downtime of Contractor, sub-contractors and personnel.
- 32 C. CxA shall provide notification to all parties requested to attend a specific meeting in accordance with the format,
33 quantity and timeframe defined under SUBMITTALS for this section. Notification shall include a formal agenda of the
34 meeting, including the anticipated duration and attendees required.
- 35 D. Contractor, Architect and Owner shall be responsible to have personnel requested in attendance at meeting for
36 duration specified by CxA. If people requested are not available then Contractor, Architect or Owner shall provide
37 notice to CxA and provide a substitute.
- 38 E. CxA shall supply all attending parties with a formal copy of the minutes for the meeting in accordance with the
39 format, quantity and timeframe defined under SUBMITTALS for this section.
- 40 F. Attending parties shall have 7 days from receipt of minutes to formally comment to CxA on changes to minutes.
- 41

42 3.12 TAB VERIFICATION

- 43 A. TAB Plan:
- 44 1. 90 days prior to TAB, Contractor is to provide Architect and CxA with a complete copy of the TAB plan for the
45 project. TAB plan shall include at a minimum the following information:
 - 46 a. Review contract documentation, submittals and installations for each system requiring TAB. Provide
47 comments on any conditions of design and installation that will preclude proper TAB of facility.
 - 48 b. Copy of qualifications and certifications for technicians to be utilized for TAB work
 - 49 c. Step by step procedures detailing the methods to be utilized for balancing of each system and equipment
50 type present. Procedures shall be of sufficient detail to ensure repeatable measurement, as well as include
51 procedures to be utilized for examination and preparation prior to TAB.
 - 52 d. Pre-populated TAB report in format specified under Division 23 Section "Testing Adjusting, and Balancing
53 for HVAC." TAB report shall include design and submitted performance data for facility equipment and
54 systems.
 - 55 2. CxA shall provide comments to Architect for review and incorporation into the Architect response to the
56 submittal in accordance with part 3.5 of this section

- 1 3. Architect shall provide CxA with responses to all comments issued by CxA via CxA provided issues management
- 2 system in concurrence with formal response and action for TAB plan to Contractor in accordance with part 3.5 of
- 3 this section.
- 4 4. Contractor shall utilize approved TAB plan as basis for all TAB work to be performed on site. CxA shall in turn
- 5 utilize the TAB plan as the basis for establishment of the TAB verification plan and the body of record for
- 6 reviewing the procedures utilized by Contractor in the verification of TAB.
- 7 B. TAB Report:
- 8 1. Contractor shall supply Architect and CxA with a complete copy of the TAB report for the facility in accordance
- 9 with the format, quantity and timeframe defined under SUBMITTALS for this section. Report is to meet the
- 10 requirements stated under 230593-Testing Adjusting, and Balancing for HVAC.
- 11 2. CxA shall provide comments to Architect for review and incorporation into the Architect response to the
- 12 submittal in accordance with part 3.5 of this section
- 13 3. Architect shall provide CxA with responses to all comments issued by CxA via CxA provided issues management
- 14 system in concurrence with formal response and action for TAB report to Contractor in accordance with part 3.5
- 15 of this section.
- 16 4. If any deficiencies are noted in TAB report comments from the Architect that are related to the methods utilized
- 17 or results of TAB, Contractor shall remedy said issues and inform Architect and CxA of completion, including
- 18 provision of revised TAB report.
- 19 C. TAB Verification:
- 20 1. A minimum verification sample of 10% of the total terminal points and a minimum verification sample of 25% of
- 21 the total major equipment points under the work of TAB shall be included for TAB verification. CxA shall define
- 22 the overall sampling approach and rate to be utilized for TAB verification within the Cx plan provided to the team
- 23 at the outset of the project construction.
- 24 2. System is to be verified under normal operating conditions and automatic control as detailed in TAB Plan.
- 25 System overrides are to be initiated only upon the discretion of CxA.
- 26 3. CxA shall provide Architect, Owner and Contractor with formal TAB verification report. Report shall include at a
- 27 minimum the following:
- 28 a. Lists of areas and equipment sampled
- 29 b. TAB report and verification values for each point sampled
- 30 c. Overall recommendation for approval of TAB
- 31 4. Any deficiencies identified during TAB verification by CxA shall be reported via the CxA provided web issues
- 32 management system. A issue as it pertains to TAB verification shall be any value recorded that is greater than
- 33 the TAB report value +/- the tolerance permitted under 230593-Testing Adjusting, and Balancing for HVAC, or
- 34 the value recorded is greater than the design value +/- the tolerance permitted under 230593-Testing Adjusting,
- 35 and Balancing for HVAC.
- 36 5. Contractor shall re-balance any systems impacted by deficiencies noted during TAB verification to the
- 37 satisfaction of the Architect and supply CxA with a detailed resolution report via CxA provided issues
- 38 management system in accordance with the format, quantity and timeframe defined under SUBMITTALS for this
- 39 section. Responses shall include the following information as applicable:
- 40 a. Method of resolution.
- 41 b. Date of resolution.
- 42 c. List of similar installations and areas reviewed and resolved.
- 43 d. Reference documentation, including revised TAB report
- 44

3.13 FUNCTIONAL PERFORMANCE AND SEASONAL TESTING

- 45 A. See 019120-Commissioning (Cx) Functional Performance Testing.
- 46
- 47

3.14 OPERATION AND MAINTENANCE DATA

- 48 A. Contractor shall supply O&M data in format, quantity and timeframe as defined under 017823 Operation and
- 49 Maintenance Data.
- 50 B. CxA shall provide comments to Architect for review and incorporation into the Architect response to the O&M data
- 51 submittals in accordance with part 3.5 of this section.
- 52 C. Architect shall provide CxA with responses to all comments issued by CxA via CxA provided issues management
- 53 system in concurrence with formal response and action for O&M data submittals to Contractor in accordance with
- 54 part 3.5 of this section.
- 55 D. Any revisions or changes to the systems and/or equipment post-delivery of the final O&M data submittal must be
- 56 submitted to CxA as an addendum item. Any such submittal must adhere to specifications and be delivered within 30
- 57 days of the revision or change.
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3.15 TRAINING AND DEMONSTRATION

- A. Contractor shall supply training and demonstration documentation in format, quantity and timeframe as defined under 017900 Demonstration and Training.
- B. CxA shall provide comments to Architect for review and incorporation into the Architect response to the training and demonstration submittals in accordance with part 3.5 of this section.
- C. Architect shall provide CxA with responses to all comments issued by CxA via CxA provided issues management system in concurrence with formal response and action for training and demonstration submittals to Contractor in accordance with part 3.5 of this section.
- D. Contractor shall notify CxA of confirmation for training session at least seven (7) days prior to the scheduled start of the session.
- E. CxA shall attend and review portions of the training sessions to verify that the training program was followed. CxA shall provide comments and recommendation for action for each session attended to Architect and Owner with 7 days of session. Any sessions deemed as unacceptable or rejected by Architect or Owner shall be re-done at the convenience of the Owner, Architect and CxA in accordance with 017900 Demonstration and Training.

3.16 WARRANTY REVIEW

- A. Contractor shall supply a complete copy of all warranties applicable to the facility, the terms of maintenance for each warranty, and the inception and expiration dates for each within the O&M data and as specified under 017836 Warranties.
- B. CxA shall conduct a review of the operations and condition of the facility with respect to warranty related issues. CxA shall supply Contractor, Architect and Owner with a detailed report listing the issues identified from this walkthrough in the format, quantity and timeframe defined under SUBMITTALS for this section. This report shall include at a minimum the following:
 - 1. Description of issue identified, including photographs as applicable.
 - 2. Recommended course of action.
 - 3. Supplementary information relative to previous maintenance or repairs attempted for resolution of issue.
- C. Architect shall provide CxA with responses to all comments issued by CxA via CxA provided issues management system in concurrence with formal course of action for warranty issues noted to Contractor for resolution of issues identified.
- D. Contractor shall employ services and materials necessary for compliance to action statement from Architect. All repairs and actions taken by Contractor shall be coordinated with Owner, with a formal log of work completed provided to Owner, Architect and CxA in the format, quantity and timeframe defined under SUBMITTALS for this section.

3.17 COMMISSIONING ISSUES

- A. Throughout the course of the project and commissioning process the CxA shall identify various issues relative to deficiencies or discrepancies with the installations, submissions, or instructions provided by Contractor. These issues shall be clearly identified to Contractor, Architect and other parties of interest via CxA provided web issues management system.
- B. Contractor and Architect are ultimately responsible for resolution of all issues identified during course of project and the commissioning process. Responsible party(s) noted by CxA shall supply CxA a formal resolution report for each outstanding issue listed in the CxA provided web issues management system per the format, quantity and timeframe defined under SUBMITTALS for this section.
- C. Owner and CxA shall have the sole responsibility of determining the satisfactory completion and approval of any and all commissioning issues. CxA shall provide Architect, Contractor and Owner with action and approval of issues.
- D. Party designated by CxA as responsible for a given issue or issues shall be solely responsible for working with CxA and Owner to resolve all commissioning issues within an acceptable timeframe as agreed upon by CxA, Owner and responsible party, but no later than final acceptance of project.
- E. Issue Resolution Process:
 - 1. When there is no dispute on the issue and the responsible party accepts responsibility to correct it:
 - a. The CxA documents the issue.
 - b. The responsible party responds with indication of method for resolution to be employed within timeframe outlined under SUBMITTALS portion of this section.
 - c. Responsible party notifies CxA of completion of remediation work for issue via comment to issue in web issues management system.
 - d. CxA schedules verification of issue for next field observation, or as portion of functional performance testing block if issue is not resolved prior to start of testing.

- 1 e. CxA verifies remediation work performed by responsible party. If work is acceptable, issue is closed and
2 noted as such by CxA in web issues management system. If work is not acceptable, CxA shall re-open issue
3 with notation describing reasoning for rejection of remediation work and recommendations for closure.
4 Resolution process shall then re-start for issue.
- 5 2. If there is a dispute about an issue, regarding whether it is an issue or who is responsible:
 - 6 a. The CxA documents the issue.
 - 7 b. The responsible party responds with indication of dispute and reasoning for position.
 - 8 c. The CxA clarifies the issue further for the responsible party and re-opens to the issue to the party, or if the
9 clarification provided by the responsible party suffices to identify the issue is of no merit the issue shall be
10 closed by the CxA.
 - 11 d. If there is not further dispute by the responsible party, the process shall proceed as described under 3.17-E-
12 1.
 - 13 e. If a dispute remains, the responsible party shall further clarify the dispute within the web issues
14 management system and then generate an RFI per 012613 Request for Information *RFI).
 - 15 f. Resolutions are made at the lowest management level possible. Other parties are brought into the
16 discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the
17 Project Manager.
 - 18 g. Once the interpretation and resolution have been decided, the issue shall follow the issue resolution
19 process noted herein.
- 20 3. In the development of issues the CxA may designate an issue as "Systemic". In this situation systemic will be defined
21 as an issue that is identified and repeated in more than 20% of similar installations or units reviewed by the CxA. For
22 issues identified as "Systemic", the responsible party shall follow the issue resolution process noted, but also provide
23 evidence of review and remediation for all similar installations present on the project. The CxA shall then verify areas
24 originally identified as well as at least a sample equal to 10% additional locations or units not previously noted to
25 verify closure.
- 26 4. Cost of Verification
 - 27 1. The cost incurred by the Subs to remediate and verify an issue noted, if they are responsible for the issue, shall
28 be theirs. If they are not responsible, any cost recovery for remediation and verification costs shall be
29 negotiated with the GC.
 - 30 2. The CxA is responsible for verification of an issue one time. This verification shall occur during scheduled field
31 observations or during functional testing, but no later than the completion of the initial functional testing block.
32 Any costs incurred by the CxA for verification of issues more than once, or after the initial functional testing
33 block may be back charged to the GC, who may choose to recover costs from the responsible party identified.
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36 **END OF SECTION**
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SECTION 01 91 10
COMMISSIONING (CX) CONSTRUCTION CHECKLISTS

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PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes specifications for the implementation, tracking and verification of the commissioning construction checklists.

1.2 RELATED SPECIFICATIONS

- A. 01 32 26 Construction Progress Reporting
B. 01 33 23 Submittals
C. 01 45 16 Field Quality Control
D. 01 91 00 Commissioning (Cx) Process
E. 01 91 20 Commissioning (Cx) Functional Performance Testing

1.3 REFERENCES

- A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
B. ASHRAE Guideline 0-2005, "The Commissioning Process".
C. NEBB – Procedural Standards for Building Systems Commissioning.

1.4 DEFINITIONS

- A. Commissioning Authority (CxA) - an independent entity, not otherwise associated with the A/E team members or the Contractor and reporting directly to the Owner. The CxA directs and coordinates the commissioning activities.
B. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).
C. Construction Checklist (CC) - a list of items to verify and test equipment and components to verify proper installation of equipment. The CCs are provided by the CxA to the Contractor(s).
D. Issue - a condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the Owner's Project Requirements).
E. Owner's Project Requirements (OPR) - A document that describes what the Owner and stakeholders want to achieve with this project and what expectations they have of the completed project.
F. Sampling - reviewing or testing only a fraction of the total number of identical or near identical pieces of equipment.

1.5 DESCRIPTION

- A. The intent of the construction checklists is to provide a formalized means to provide individual workers the key criteria for a successful installation and to easily track construction progress.

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1.6 SUBMITTALS

A. The following table contains deliverables and/or submittals required under this section, the party(s) responsible for each, the frequency and or timeline these items shall be provided, the format and quantity to be provided, and the party(s) to be provided to.

Submittal	Party(s) Responsible	Frequency or Timeline	Format & Quantity	Party(s) Provided To
Construction checklists	CxA	30 days following contract award or approved equipment submittals whichever is later	Electronic	Contractor, Owner and Architect
Checklist Tracking System	CxA	30 days following contract award or approved equipment submittals whichever is later	Electronic	Contractor
PC and related software defined under the HARDWARE/SOFTWARE REQUIREMENTS for Checklist Tracking System	Contractor	30 days following contract award	N/A	N/A
List of issues requiring action	CxA	Weekly	Electronic	Contractor
Resolution report for issues	Contractor	Within 7 days of receipt of deficiency report	Electronic	Architect, CxA and Owner

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PART 2 – PRODUCTS

2.1 HARDWARE/SOFTWARE REQUIREMENTS

- A. Contractor shall provide a dedicated tablet PC or multiple tablet PCs at the site trailer for utilization in the implementation and tracking of construction verification items. This PC shall meet and/or contain the following:
1. Microsoft Windows 7 or later operating system
 2. Microsoft Office 2012 Professional or later
 3. Microsoft Internet Explorer 10 or later
 4. Minimum of 1 GB RAM
 5. Minimum of 60 GB of free hard drive space
 6. Wireless network card
 7. Cellular network card with active data agreement to be maintained for duration of project
- B. PC shall be maintained and full access provided to Owner and Contractors during typical hours of operation on site.

PART 3 - EXECUTION

3.1 COMMISSIONING TEAM

- A. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner’s Project Manager (PM), the designated representative of the Owner’s Construction Management firm (CM), Contractors, the architect and design engineers, subcontractors, and/or suppliers of equipment.
- B. Each Cx Team member shall designate one person who is responsible for coordinating the commissioning efforts with the CxA.

3.2 DEVELOPMENT PROCEDURES

- A. Construction checklists shall be developed for each system or equipment to be commissioned. A list of the commissioned systems is located under 019100 Commissioning (Cx) Process.
- B. CxA shall be responsible to provide Contractor with copies of each checklist to be utilized for this project for each equipment/system type per the format, quantity and timeframe defined under SUBMITTALS for this section. An example for checklists is provided in Annex A showing the rigor and format to be used.
- C. Checklists shall be provided in the following formats:
1. Equipment: Checklists related to a specific piece of equipment or portion of an overall system that is completed in a linear progression similar to the standard installation practices of the equipment.

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- 1 2. System: Checklists related to the overall distribution system or repetitive equipment found universally
2 throughout a given system (i.e. valves, diffusers, outlets, etc.).
- 3 D. Contractor and Architect are responsible to provide notice to CxA for any project modifications related to the addition
4 or deletion of equipment and/or systems to be commissioned.
- 5 E. CxA shall provide contractor with the following items to the Contractor upon issuance of checklists and checklist
6 tracking system:
- 7 1. Instructions for completion and utilization of checklists and tracking system.
- 8 2. Checklists for all equipment and systems in the following format:
- 9 a. Short Form: Electronic checklists divided into individual groups divided by trade and step of installation with
10 each trade Contractor responsible for the completion of each checklist group. Each group to be provided
11 and tracked as an individual checklist. Checklist shall include area to mark checklist as complete. Checklists
12 to include ability for notation of any deficiencies identified during verification of installation.

13 **3.3 COMPLETION PROCEDURE**

- 14 A. The following is the permitted method the Contractor is to utilize for completion of all construction verification
15 checklists related to project. Any deviations from this procedure must be authorized by the CxA.
- 16 B. Equipment Checklists:
- 17 1. The checklist shall be completed by the individual completing the work who is responsible for the given delivery
18 or installation step of the equipment utilizing the provided tablet PC or other Internet capable platform
19 compatible with CxA provided checklist tracking system in the field.
- 20 2. Checklists shall be completed fully with all information or responses noted in the spaces provided for each item.
21 Any items that cannot be answered due to lack of information with equipment or not being applicable to a given
22 installation shall be noted negatively, with an explanation provided in the deficiency section.
- 23 3. Any negative responses on the checklist shall be explained and documented within the issues section.
24 Explanation shall be detailed to a degree to define the reasoning for non-compliance without further
25 observation.
- 26 4. Once all items on a checklist have been completed, individual shall submit that group/checklist marking it as
27 complete.
- 28 5. At end of work week Contractor to review available tracking reports in Checklist Tracking System and verify
29 progress is in line with noted work to date.
- 30 6. CxA shall periodically review issue reports contained within the Checklist Tracking System and provide the
31 Contractor a list of issues requiring action by Contractor per the format, quantity and timeframe defined under
32 SUBMITTALS for this section.
- 33 7. Contractor to record method and date of resolution upon completion of corrective action for any issue or non-
34 compliance item noted as requiring action by CxA per the format, quantity and timeframe defined under
35 SUBMITTALS for this section.
- 36 8. The completion of the checklists does not eliminate the Contractor's responsibility for meeting other
37 requirements in the specifications and drawings.
- 38 C. System Checklists:
- 39 1. The checklist shall be completed by the individual completing the work who is responsible for the given
40 installation of the system utilizing the provided tablet PC or other Internet capable platform compatible with CxA
41 provided checklist tracking system in the field.
- 42 2. Individual to periodically record the work completed for the given system and installation step in accordance
43 with the completion of work for the system and given installation step equaling the prescribed milestone
44 completion percentages established by the CxA within the Checklist Tracking System.
- 45 3. Checklists shall be completed fully with all information or responses noted in the spaces provided for each item.
46 Any items that cannot be answered due to lack of information with equipment or not being applicable to a given
47 installation shall be noted negatively, with an explanation provided in the issues section.
- 48 4. Any negative responses on the checklist shall be explained and documented within the issues section.
49 Explanation shall be detailed to a degree to define the reasoning for non-compliance without further
50 observation.
- 51 5. Once all items on a checklist have been completed, individual shall submit that group/checklist marking it as
52 complete.
- 53 6. At end of work week Contractor to review available tracking reports in Checklist Tracking System and verify
54 progress is in line with noted work to date.
- 55 7. CxA shall periodically review issue reports contained within the Checklist Tracking System and provide the
56 Contractor a list of issues requiring action by Contractor per the format, quantity and timeframe defined under
57 SUBMITTALS for this section.

- 1 8. Contractor to record method and date of resolution upon completion of corrective action for any issue or non-
2 compliance item noted as requiring action by CxA per the format, quantity and timeframe defined under
3 SUBMITTALS for this section.
4 9. The completion of the checklists does not eliminate the Contractor's responsibility for meeting other
5 requirements in the specifications and drawings.

6 **3.4 VERIFICATION PROCEDURE**

- 7 A. At the commencement of work related to the checklists the CxA will periodically verify the accuracy, completeness
8 and tracking of the checklists in accordance with the CxA defined sampling method and rate. This verification shall
9 consist of reviewing the as installed conditions of the equipment and/or system versus the statements recorded on
10 the checklists and the progress of the checklists in general.
11 B. CxA shall record any discrepancies noted between the as installed conditions and/or progress of installation versus
12 the checklists in the Checklist Tracking System and/or field observation report. Any items noted as requiring action by
13 CxA shall be issued to Contractor per the format, quantity and timeframe defined under SUBMITTALS for this section
14 and in accordance with 019100-Commissioning (Cx) Process.
15 C. If during verification the CxA identifies a discrepancy rate for items identified on an individual checklist, or for the
16 overall item count for the checklists for a given equipment or system greater than or equal to the defined sampling
17 rate, the Contractor shall re-validate 100% of the checklists, equipment and/or system.
18 D. Contractor shall provide CxA method and date of resolution upon completion of corrective action for and discrepancy
19 noted by CxA and similar installations via the CxA web issues management system per the format, quantity and
20 timeframe defined under SUBMITTALS for this section and in accordance with 019100-Commissioning (Cx) Process.
21 E. Any discrepancies noted for action that are disputed by Contractor and cannot be resolved between the Contractor
22 and the CxA, shall be presented to Owner and Architect for resolution via the CxA provided web issues management
23 system and in accordance with 019100-Commissioning (Cx) Process.
24 F. If during verification the CxA identifies more than a 10% discrepancy rate between the current installation completion
25 percentage for a given equipment or system and that reflected in the current checklists, the Contractor will be given a
26 written warning within the applicable field observation report issued by the CxA regarding this issue and shall be
27 responsible to bring the checklist completion in line with the installation progress by the next scheduled CxA visit. If
28 this issue is not resolved by the next CxA visit and/or occurs again during the course of the project, the Contractor can
29 be back charged by the Owner to have the CxA review 100% of all un-completed checklists required to bring the
30 checklist completion in line with the installation progress.
31

ANNEX A – SAMPLE CONSTRUCTION VERIFICATION CHECKLIST

The following checklist is provided as an example only. The content and format does not necessarily reflect the final scope, format or system to be utilized for this project.

TEST

AHUs, HW-CHW: Bldg BLDG 1, Area -, TEST

Item	Task Description	Submitted	Response	
			Delivered	
A	Model Verification - Mechanical Contractor			
1	Manufacturer			
2	Model Number			
3	Serial Number	N/A		
4	# of Supply Fans			
5	Supply Air Flow / External Static Pressure (cfm / in W.C.)	/	/	
6	Outside Air Flow (cfm)			
7	Chilled Water Cooling Capacity (MBH / gpm)	/	/	
8	Number of Chilled Water Cooling Coils			
9	Chilled Water Cooling Coil # of Rows per Coil			
10	Hot Water Heating Capacity (MBH / gpm)	/	/	
11	Number of Hot Water Heating Coils			
12	Hot Water Heating Coil # of Rows per Coil			
13	Supply Fan Motor Speed / Power (rpm / hp)	/	/	
14	Voltage / Phase / Frequency (V / - / Hz)	/ /	/ /	
15	NEMA Nominal Efficiency			
B	Physical Checks - Mechanical Contractor			Response
1	Unit is free of physical damage.		Yes	No
2	Coil surface areas are free of damage.		Yes	No
3	Air openings are sealed with plastic.		Yes	No
4	Water openings are sealed with plastic plugs.		Yes	No
5	Boot connection between unit and duct connection tight and in good condition.		Yes	No
6	All components/accessories present.		Yes	No
7	All access doors are operable.		Yes	No
8	Installation and startup manual present with unit.		Yes	No
9	Manufacturer's ratings readable.		Yes	No
10	Cx unit tags affixed.		Yes	No
A	Installation - Mechanical Contractor			Response
1	Concrete housekeeping pad or other support method to accommodate weight of unit provided.	Yes		No
2	Concrete housekeeping pad or other support method is of sufficient height to accommodate condensate trap depth.	Yes	Yes	No
3	Unit secured and supported as required by manufacturer and specifications including specified vibration isolation devices.		Yes	No
4	Unit is totally isolated (without rigid contact) from structure, ductwork or other stationary equipment or devices.	Yes	Yes	No
5	Unit sections attached per manufacturer instructions.		Yes	No
6	Unit is level and all sections plumb and square.		Yes	No
7	Adequate clearance around unit for service per manufacturer's requirements.		Yes	No
8	All components accessible for maintenance.		Yes	No
9	Cooling coil drain pan slopes correctly.		Yes	No
10	Shipping bolts have been removed and internal isolators have free movement.		Yes	No
11	All Inspection and access doors are operable and sealed.		Yes	No
12	Construction filters provided in unit per specification requirements.		Yes	No
B	Hot Water Piping - Mechanical Contractor			Response
1	Piping arranged for ease of unit/coil removal.		Yes	No
2	Unit piping arranged for counter flow arrangement.		Yes	No
3	Coil connected to water supply and return piping using unions or flanges and isolation valves.		Yes	No

1	4	All piping components have been installed (in the correct order) as required by contract documents.	Yes	No
2	5	Dielectric fittings installed to isolate dis-similar pipe materials.	Yes	No
3	6	Separate air vent and drain valve provided for each coil header outside of unit or ductwork	Yes	No
4	7	Sufficient clearance is provided between piping, fittings and valves to allow the application of full thickness pipe insulation	Yes	No
5				
6	8	Piping supported as required by specifications.	Yes	No
7	9	Valve handles will not interfere with adjacent piping or pipe insulation when operated.	Yes	No
8	10	All valves and test ports are easily accessible.	Yes	No
9		C Chilled Water Piping - Mechanical Contractor		Response
10	1	Piping arranged for ease of unit/coil removal.	Yes	No
11	2	Unit piping arranged for counter flow arrangement.	Yes	No
12	3	Coil connected to water supply and return piping using unions or flanges and isolation valves.	Yes	No
13	4	All piping components have been installed (in the correct order) as required by contract documents.	Yes	No
14	5	Dielectric fittings installed to isolate dis-similar pipe materials.	Yes	No
15	6	Separate air vent and drain valve provided for each coil header outside of unit or ductwork	Yes	No
16	7	Sufficient clearance is provided between piping, fittings and valves to allow the application of full thickness pipe insulation	Yes	No
17				
18	8	Piping supported as required by specifications.	Yes	No
19	9	Valve handles will not interfere with adjacent piping or pipe insulation when operated.	Yes	No
20	10	All valves and test ports are easily accessible.	Yes	No
21	11	Trap provided for condensate drain line and line run to nearest floor drain.	Yes	No
22		D Ductwork - Mechanical Contractor		Response
23	1	Adequate locations available for testing and balancing of unit.	Yes	No
24	2	All dampers and sensors are accessible (access panels).	Yes	No
25	3	All dampers close tightly and stroke fully and easily.	Yes	No
26	4	Ductwork is clean and free of debris.	Yes	No
27	5	Outdoor and return air arrangement will not freeze coils, i.e. outdoor air and return air are adequately mixed before reaching coils.	Yes	No
28				
29	6	Ductwork is properly supported externally and internally.	Yes	No
30	7	Flexible duct connections of proper material installed at each duct connection.	Yes	No
31	8	Flexible duct connections are properly sealed.	Yes	No
32		E Electrical - Electrical Contractor		Response
33	1	Local disconnect installed in accessible location within sight of unit it controls.	Yes	No
34	2	Each motor terminal box is connected with a minimum 12", maximum 36" piece of flexible conduit to a fixed junction box.	Yes	No
35				
36	3	Motor NEMA Nominal Efficiency complies with specifications.	Yes	No
37	4	VFD installed and installation verified.	Yes	No
38	5	All electrical connections are tight.	Yes	No
39	6	All electrical components are grounded.	Yes	No
40	7	Connections match unit wiring diagram.	Yes	No
41	8	Internal lighting works properly.	Yes	No
42	9	External receptacle has power.	Yes	No
43	10	Motor rotation is in the proper direction.	Yes	No
44	11	Motor windings resistance has been verified to be 6 meg-ohms or above.	Yes	No
45		F Controls - Installation - Controls Contractor		Response
46	1	Control panel accessible and labeled properly.	Yes	No
47	2	All sensors and actuators installed per contract documents.	Yes	No
48	3	Proper location and installation of duct static pressure sensor verified and acceptable.	Yes	No
49	4	All safety items installed per contract documents.	Yes	No
50	5	Freezestat or low temperature limit sensor wire run provides full coverage of coil per manufacturer's recommendations.	Yes	No
51				
52	6	All control wiring installed and communication verified.	Yes	No
53	7	Smoke detectors installed and communication verified with BAS and fire alarm systems.	Yes	No
54	8	Test ports installed at all control sensors.	Yes	No
55		G Pre-Mechanical - Startup - Mechanical Contractor		Response
56	1	Unit is clean.	Yes	No
57	2	Internal isolators free to move.	Yes	No

1	3	Fans and motors lubricated and aligned.	Yes	No	
2	4	Angular mis-alignment of motor and unit shafts does not exceed 0.02 in per diameter of coupling hub.	Yes	No	
3	5	Belt sheaves have been properly aligned per contract documents.	Yes	No	
4	6	Bearing set screws have torque per manufacturer recommendations.	Yes	No	
5	7	Fan belts have proper tension and are in good condition.	Yes	No	
6	8	Protective shrouds for fans and belts in place and secure.	Yes	No	
7	9	Fire, smoke, and terminal unit dampers manually opened or are controllable and open.	Yes	No	
8	10	Filters installed properly (no bypass air) and are clean.	Yes	No	
9	11	Chilled water piping pressure tested, flushed and filled (reports submitted).	Yes	No	
10	12	Hot water piping pressure tested, flushed and filled (reports submitted).	Yes	No	
11	13	Proper water treatment has been done to ensure no scaling, erosion, corrosion, algae, or slime is present in each hydronic system.	Yes	Yes	No
12					
13	14	Condensate drainage is unobstructed.	Yes	No	
14	15	Any damage to coil fins has been repaired.	Yes	No	
15	H	Mechanical - Startup - Mechanical Contractor		Response	
16	1	System starts and runs without any unusual noise or vibration.	Yes	No	
17	2	Fan rotates in proper direction.	Yes	No	
18	3	Motor voltage imbalance checked and is acceptable per manufacturer's recommendations.	Yes	No	
19	4	Belt tension checked after initial startup and acceptable.	Yes	No	
20	5	Disconnect switch operation verified and acceptable.	Yes	No	
21	6	Manufacturer's startup checklist completed (report submitted).	Yes	No	
22	7	Filters installed properly (no bypass air) and are clean.	Yes	No	
23	I	Controls - Startup - Controls Contractor		Response	
24	1	Point-to-point checkout completed and report attached.	Yes	No	
25	2	All sensors and actuators calibrated per contract documents and within accepted tolerances (report submitted).	Yes	No	
26	3	All valves proven to have no leak by at normal operating pressure per contract document requirements (report submitted).	Yes	No	
27					
28	4	All actuated dampers proven to have full range of motion without any hitches and full closure (report submitted).	Yes	Yes	No
29	5	All sequences of control verified and acceptable.	Yes	No	
30	6	Smoke damper interlock verified and acceptable.	Yes	No	
31	7	All safeties and alarms verified and acceptable.	Yes	No	
32	8	Central system and graphics accurately represents conditions of unit.	Yes	No	
33	J	TAB - TAB Contractor		Response	
34	1	Final filters installed, clean and sealed (no bypass air).	Yes	No	
35	2	Motor rotation verified to be in proper direction – each motor.	Yes	No	
36	3	Motor overload verified and acceptable.	Yes	No	
37	4	Motor voltage and amps verified for each phase and are acceptable.	Yes	No	
38	5	Phase imbalance less than 2%.	Yes	No	
39	6	FLA is less than rated FLA times service factor.	Yes	No	
40	7	Final TAB values for unit complies with contract documents and listed tolerances.	Yes	No	
41	8	All settings and positions of TAB have been permanently labeled on unit and/or component.	Yes	No	
42	K	Finalization - Mechanical Contractor		Response	
43	1	Piping insulation is complete and sealed as per specifications, no exposed insulation can be seen.	Yes	No	
44	2	Valve tags attached.	Yes	No	
45	3	Ductwork insulation is complete and sealed as per specifications, no exposed insulation can be seen.	Yes	No	
46	4	All damage to unit finish is repaired.	Yes	No	
47	5	All electrical wiring and motors labeled per contract document requirements.	Yes	No	
48	6	All control wiring and devices labeled per contract document requirements.	Yes	No	
49	7	Unit tags affixed.	Yes	No	
50	8	Belt tension verified and adjusted after 80 hours of operation.	Yes	No	
51					
52					
53		END OF SECTION			

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SECTION 01 91 20
COMMISSIONING (CX) FUNCTIONAL PERFORMANCE TESTING

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PART 1 – GENERAL

1.1 SUMMARY

- A. Section includes specifications for the implementation, tracking and verification of the commissioning functional performance tests.

1.2 RELATED SPECIFICATIONS

- A. 01 32 26 Construction Progress Reporting
B. 01 33 23 Submittals
C. 01 45 16 Field Quality Control
D. 01 91 00 Commissioning (Cx) Process
E. 01 91 10 Commissioning (Cx) Construction Checklists

1.3 REFERENCES

- A. ASHRAE Guideline 1.1-2007, "HVAC&R Technical Requirements for The Commissioning Process".
B. ASHRAE Guideline 0-2005, "The Commissioning Process".
C. NEBB – Procedural Standards for Building Systems Commissioning.

1.4 DEFINITIONS

- A. Acceptance Phase - phase of construction after startup and initial checkout when functional performance tests are performed.
B. Commissioning Authority (CxA) - an independent entity, not otherwise associated with the A/E team members or the Contractor and reporting directly to the Owner. The CxA directs and coordinates the commissioning activities.
C. Commissioning Plan (Cx Plan) - an overall plan, developed before or after bidding, that provides the structure, schedule and coordination planning for the commissioning process.
D. Contract Documents - the documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).
E. Construction Checklist (CC) - a list of items to verify and test equipment and components to verify proper installation of equipment. The CCs are provided by the CxA to the Contractor(s).
F. Datalogging - monitoring flows, currents, status, pressures, etc. of equipment using stand-alone dataloggers separate from the control system.
G. Deferred Functional Performance Tests - FPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that prevent the tests from being performed earlier.
H. Factory Testing - testing of equipment on-site or at the factory by factory personnel with an Owner's representative present.

- 1 I. Indirect Indicators - indicators of a response or condition, such as a reading from a control system screen reporting
- 2 a damper to be 100% closed.
- 3 J. Issue - a condition in the installation or function of a component, piece of equipment or system that is not in
- 4 compliance with the Contract Documents (that is, does not perform properly or is not complying with the Owner's
- 5 Project Requirements).
- 6 K. Manual Test - using hand-held instruments, immediate control system readouts or direct observation to verify
- 7 performance (contrasted to analyzing monitored data taken over time to make the "observation").
- 8 L. Monitoring - the recording of parameters (flow, current, status, pressure, etc.) of equipment operation using
- 9 dataloggers or the trending capabilities of control systems.
- 10 M. Over-written Value - writing over a sensor value in the control system to see the response of a system (e.g.,
- 11 changing the outside air temperature value from 75F to 50F to verify economizer operation). See also "Simulated
- 12 Signal."
- 13 N. Owner's Project Requirements (OPR) - A document that describes what the Owner and stakeholders want to
- 14 achieve with this project and what expectations they have of the completed project.
- 15 O. Sampling - reviewing or testing only a fraction of the total number of identical or near identical pieces of
- 16 equipment.
- 17 P. Seasonal Performance Tests - SPT's that are deferred until the system(s) will experience conditions closer to their
- 18 design conditions.
- 19 Q. Simulated Condition - condition that is created for the purpose of testing the response of a system (e.g., applying a
- 20 hair blower to a space sensor to see the response in a VAV box).
- 21 R. Simulated Signal - disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure
- 22 to the transducer and DDC system to simulate a sensor value.
- 23 S. Functional Performance Test (FPT) - Dynamic testing of entire systems (rather than just components of the system)
- 24 under full operation.
- 25 T. Trending - monitoring using the building automation system.

26
27 **1.5 DESCRIPTION**

- 28 A. The intent of the functional performance tests is to provide a formalized means to verify the completion and
- 29 functional preparedness of the commissioned systems for operation and occupancy.

30
31 **1.6 SUBMITTALS**

- 32 A. The following table contains deliverables and/or submittals required under this section, the party(s) responsible for
- 33 each, the frequency and or timeline these items shall be provided, the format and quantity to be provided, and the
- 34 party(s) to be provided to.

Submittal	Party(s) Responsible	Frequency or Timeline	Format & Quantity	Party(s) Provided To
Review comments on draft FPT procedures	Contractor, Architect	Within 7 days of receipt of FPT procedures	Electronic	CxA
Final FPT procedures	CxA	Within 7 days of receipt of FPT procedure comments	Electronic	Contractor, Owner, Architect
Contractor readiness notification	Contractor	21 days prior to commencement of testing	Electronic	Contractor, Owner, Architect
FPT readiness confirmation	Contractor	14 days prior to commencement of testing	Electronic	CxA, Owner, Architect
FPT plan	CxA	7 days prior to commencement of testing	Electronic	Architect, Owner, Contractor
Remote Review Summary	CxA	Within 7 days prior to commencement of testing	Electronic	Architect, Owner, Contractor
Preliminary FPT report and list of deficiencies requiring action	CxA	Within 14 days of completion of testing	Electronic	Contractor, Owner, Architect
Resolution report for FPT deficiencies	Contractor	Within 7 days of receipt of report	Electronic	Architect, Owner and CxA
FPT Re-Testing readiness confirmation (if applicable)	Contractor	14 days prior to commencement of testing	Electronic	CxA, Owner, Architect
FPT re-test plan (if applicable)	CxA	7 days prior to commencement of testing	Electronic	Architect, Owner, Contractor

Submittal	Party(s) Responsible	Frequency or Timeline	Format & Quantity	Party(s) Provided To
Final FPT report	CxA	Within 14 days of completion of re-testing (if applicable)	Electronic	Architect, Owner, Contractor
Preliminary seasonal testing report and list of deficiencies requiring action	CxA	Within 14 days of completion of testing	Electronic	Architect, Owner, Contractor
Resolution report for seasonal test deficiencies	Contractor	Within 7 days of receipt of report	Electronic	Architect, Owner, CxA
Seasonal Re-Testing readiness confirmation (if applicable)	Contractor	14 days prior to commencement of testing	Electronic	CxA, Owner, Architect
Final seasonal testing report	CxA	Within 14 days of receipt of report	Electronic	Architect, Owner, Contractor

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1.7 TEST METHODS

- A. FPT is achieved in accordance with the procedures outlined by the CxA and as outlined by the body of the Contract Documents. For the purpose of clarity CxA may require Contractor to employ one of the following methods below:
 - 1. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.
 - 2. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting shall be allowed, but shall be used with caution and avoided when possible.
 - 3. Simulated Signals. Using a signal generator which creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.
 - 4. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable.
 - 5. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses.
- B. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy as defined by CxA within the Cx plan provided per 019100-Commissioning (Cx) Process.

PART 2 – PRODUCTS

2.1 TEST EQUIPMENT

- A. All standard testing equipment required to perform startup, initial checkout, additional testing and required functional performance testing shall be provided by Contractor for the equipment being tested.
- B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and left on site, except for stand-alone datalogging equipment that may be used by the CxA.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or – 0.1°F.
 - 2. Pressure sensors shall have an accuracy of + or – 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
 - 3. All equipment shall be calibrated according to the manufacturer’s recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 DEVELOPMENT PROCEDURES

- A. FPT procedures shall be developed for each system and equipment to be commissioned. For the purpose of clarity it can assumed the following tests with a total minimum duration of [TBD] hours will be required:
 - 1. Hot Water System
 - 2. Air Distribution Systems
 - 3. Exhaust Systems
 - 4. Domestic Cold Water Systems
 - 5. Domestic Hot Water Systems

- 1 6. Energy Management & Control Systems (BAS)
- 2 7. Indoor Lighting and Control Systems
- 3 8. Outdoor Lighting and Control Systems
- 4 9. Energy Metering
- 5 10. Miscellaneous HVAC Equipment
- 6 11. Unitary AC Equipment
- 7 B. Contractor and Architect are responsible to review the FPT procedures provided by CxA and provide any comments
- 8 or issues related to the specified FPT procedures per the format, quantity and timeframe defined under
- 9 SUBMITTALS for this section. Failure to provide comments on the FPT procedures shall constitute full acceptance
- 10 as written and obligation of Contractor to full warrant the application, safety and warranty terms of the equipment
- 11 and system under the conditions presented by the tests specified.
- 12 C. Contractor and Architect are responsible to provide notice to CxA for any project modifications related to the
- 13 addition or deletion of equipment and/or systems to be commissioned.
- 14 D. CxA shall incorporate any comments from the Contractor and Architect that are not deemed in contradiction to the
- 15 scope of the project, applicable codes and standards, and the OPR of the project.
- 16

17 **3.2 CONTRACTOR READINESS**

- 18 A. The following conditions shall constitute the definition of contractor readiness. The Contractor shall be responsible
- 19 to formally provide written confirmation of compliance with all criteria per part 1.3 of this section, including
- 20 sufficient background documentation as requested by CxA, Architect or Owner.
- 21 1. Completed copies of all pre-functional checklists for equipment and systems pertaining to commissioned
- 22 system and related systems.
- 23 2. Written and approved notification of the resolution of all issues and discrepancies noted for equipment and
- 24 systems pertaining to commissioned systems.
- 25 3. Completed and approved copies of all start-up, testing, certification and balancing reports specified for
- 26 equipment and systems pertaining to commissioned system.
- 27 4. Documentation of preliminary functional testing results as performed by Contractor.
- 28 B. Readiness requested by the contractor that is found to be incomplete or not to have sufficient documentation
- 29 supporting completion of all readiness criteria noted within this part as determined by the CxA, shall be deemed
- 30 rejected and require re-submission by contractor with additional documentation as requested by CxA. Any and all
- 31 delays, including additional costs incurred by Architect, Owner and CxA due to this rejection shall be the burden of
- 32 the contractor at no additional cost to the Owner.
- 33

34 **3.3 PRE-INIMPLEMENTATION PROCEDURE**

- 35 A. The following is the permitted method the Contractor is to utilize prior to implementation of all FPTs related to
- 36 project. Any deviations from this procedure must be authorized by the CxA.
- 37 1. CxA supplies Contractor and Architect with FPT procedures.
- 38 2. Contractor and Architect review FPT procedures and provide comments to CxA.
- 39 3. Contractor provides contractor readiness notification for commissioned systems per part 1.6 of this section.
- 40 4. Contractor provides CxA with confirmation of FPT readiness per part 1.6 of this section.
- 41 5. CxA provides Contractor with FPT plan per part 1.6 of this section.
- 42

43 **3.4 IMPLEMENTATION PROCEDURE**

- 44 A. CxA is NOT responsible for the operation of equipment/systems and/or conducting the testing on the
- 45 equipment/systems. CxA is only responsible for witnessing, reporting and approving the tests conducted by the
- 46 Contractor. Contractor is fully responsible for operation of equipment/systems and conducting the testing on the
- 47 equipment/system specified under the FPT procedures to the satisfaction of CxA. In addition, Contractor is
- 48 responsible to ensure all equipment and systems are returned to normal operation state at conclusion of testing
- 49 each day.
- 50 B. The following is the permitted method the Contractor is to utilize for implementation of all FPT related to project.
- 51 Any deviations from this procedure must be authorized by the CxA prior to testing.
- 52 C. One week prior to scheduled start of testing, CxA shall perform a preliminary review of the BAS graphics and trends
- 53 established by the contractor for all commissioned systems available. The CxA shall utilize this review as a means
- 54 to determine the final readiness of the project to proceed with formal testing. If the CxA determines that the level
- 55 of graphics, trending and/or issues noted are to a degree that warrant the delay to start testing, the CxA shall
- 56 provide a recommendation of delay to the Contractor, Architect and Owner with a summary of findings.
- 57 Contractor shall then have 2 days to request a delay and submit a schedule for completion of noted issues to the
- 58 CxA, Architect and Owner, or testing will remain scheduled to start as requested initially. If the CxA determines

- 1 that the level of graphics, trending and/or issues noted are not to a degree that warrant the delay to start testing,
2 the CxA shall provide a summary of findings to the contractor, Architect and Owner and no further action is
3 required of the contractor.
- 4 D. On day of scheduled test Contractor shall have personnel and tools present to accomplish test. If required
5 personnel and/or tools are not present Contractor shall be responsible for re-testing in accordance with the
6 requirements specified under RE-TESTING PROCEDURE of this section.
- 7 E. Contractor shall ensure BAS and/or data logging equipment is set-up for trending specified for each test prior to
8 initiation of test.
- 9 F. Contractor shall implement testing according to approved FPT procedures and plan unless directed by CxA.
- 10 G. If at any point, frequent failures are occurring and testing is requiring excessive troubleshooting, CxA may stop the
11 testing and require the responsible Contractor to perform and document a checkout of the remaining units and
12 systems, prior to continuing with functional testing. Failures of this nature shall constitute a re-test and handled in
13 accordance with the guidelines specified for re-testing under this section.
- 14 H. If issues are identified during the test, CxA shall clearly identify the issue in the FPT report and via CxA provided
15 web issues management system. Upon resolution of these issues Contractor shall supply CxA with report via CxA
16 provided web issues management system detailing proposed method and schedule of resolution per the format,
17 quantity and timeframe defined under SUBMITTALS for this section.
- 18 I. CxA is solely responsible for defining what constitutes an issue during a test.
- 19 J. At the completion and approval of all tests CxA shall provide Architect, Owner and Contractor with final copy of FPT
20 results.
- 21 K. The completion of the FPT does not eliminate the Contractor's responsibility for meeting other testing
22 requirements in the specifications and drawings.

23 24 **3.5 SEASONAL TESTING PROCEDURE**

- 25 A. Portions of or tests in whole are required to be run under near peak load conditions. For these instances the
26 Contractor will be required to attend and implement seasonal tests under the direction of CxA.
- 27 B. CxA shall develop and issue a seasonal test plan to Contractor 7 days prior to the commencement of seasonal
28 testing, which shall have the same format and detail required for the FPT plan defined in this section.
- 29 C. Contractor and CxA shall follow identical procedure defined for FPT under this section for all seasonal tests,
30 including methods for issue resolution and re-testing.
- 31 D. At the completion and approval of all tests CxA shall provide Architect, Owner and Contractor with final copy of
32 seasonal test report.
- 33 E. The completion of the seasonal tests does not eliminate the Contractor's responsibility for meeting other testing
34 requirements in the specifications and drawings.

35 **3.6 NON-CONFORMANCE AND APPROVAL OF TESTING**

- 36 A. Non-Conformance
- 37 1. If any issues or non-conformance are noted the Contractor shall remedy said issues until satisfactory
38 performance is achieved in accordance with re-testing guidelines provided under this section and inform
39 Architect and CxA of completion for re-testing per the format, quantity and timeframe defined under
40 SUBMITTALS for this section.
- 41 B. Failure Due to Manufacturer Defect
- 42 1. If 10%, or three, whichever is greater, of identical pieces of equipment fail to perform to the Contract
43 Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted
44 performance spec, all identical units may be considered unacceptable by the Architect or Owner. In such case,
45 the Contractor shall provide the Owner with the following:
- 46 a. Within 7 days of notification from the Architect or Owner, the Contractor or manufacturer's
47 representative shall examine all other identical units making a record of the findings.
- 48 b. Within 14 days of the original notification, the Contractor or manufacturer's representative shall provide
49 a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions
50 which shall include full equipment submittals to the Architect, Owner and CxA. The proposed solutions
51 shall not significantly exceed the specification requirements of the original installation.
- 52 c. Within 14 days of Contractor/Manufacturer's Representative report issuance Architect, Owner and CxA
53 will determine whether a replacement of all identical units or repair proposed is acceptable.
- 54 d. Two examples of the proposed solution will be installed by the Contractor within 30 days of approval and
55 the Architect, Owner and CxA will be allowed to review and test the installations/repairs for up to 7 days.
56 Upon the end of this review and test period the Architect and Owner will decide whether to accept the
57 solution. Cost of this re-testing for Architect, Owner and CxA shall fall under the guidelines for re-testing
58 presented in this section.

- 1 e. Upon acceptance, the Contractor and/or manufacturer's representative shall replace or repair all
2 identical items, at their expense and extend the warranty accordingly, if the original equipment warranty
3 had begun. The replacement/repair work shall proceed with reasonable speed beginning within 7 days
4 from when parts can be obtained.
- 5 2. All deficiencies, non-conformance items and failures due to manufacturer defects shall be resolved by
6 Contractor and verified and/or re-tested by CxA no later than 60 days from issuance of FPT report. Contractor
7 shall coordinate with Architect, Owner and CxA to ensure acceptable resolution of items within this time
8 period, or Owner reserves the right to withhold or alter the substantial completion to concur with final
9 acceptance of these items.

10 C. Approval

- 11 1. CxA shall have the sole responsibility of determining the satisfactory completion and approval of any and all
12 functional and seasonal tests. CxA shall provide Architect, Contractor and Owner with formal approval of each
13 functional and seasonal test as part of the final FPT report and via the CxA provided web issues management
14 system.

15 **3.7 RE-TESTING PROCEDURE**

- 16 A. CxA is responsible for attendance at one attempt per test, where an attempt is defined as the participation and
17 attendance at a test at the time approved under the FPT readiness conformation.
- 18 B. Any requirement for a re-test for a given test shall constitute the back charge to the responsible Contractor by the
19 Owner for the attendance of CxA. A re-test shall be defined in this context as any time where a test defined under
20 this section for the project cannot be fully executed due to any of the following conditions:
- 21 1. Date and time of test changed without a minimum of 3 days notice to CxA.
22 2. Improper or insufficient personnel and/or tools on site at time of test.
23 3. Deficiencies or discrepancies present at time of test that have been previously noted by CxA and remain
24 unresolved.
25 4. Any issues that require stoppage of tests in progress that result in an incomplete test or inability to execute
26 other tests within schedule time period.
27 5. ANY failure of test or portion of test for reason under responsibility of Contractor and/or Contractor
28 responsible for sub or feed system (i.e. controls, electrical, etc.).
29 6. ANY failure due to manufacturer defect.
- 30 C. The Contractor is responsible for all costs associated with re-testing, including any costs incurred by the Architect
31 and/or Owner.
- 32 D. Re-testing by Contractor shall not be considered a reason for a claim of delay or for a time extension by the
33 Contractor.
- 34 E. If any sample selected has a failure rate greater than or equal to 10% an additional sample equal to the number of
35 units that failed shall be selected and treated as a re-test in accordance with re-testing guidelines provided under
36 this section. This shall be in addition to the requirement to re-test the failed units.
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END OF SECTION

**SECTION 01 95 00
MEASUREMENT AND VERIFICATION**

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PART 1 – GENERAL

1.1 SUMMARY

A. Purpose: This section includes general requirements that apply to implementation of measurement and verification.

B. RELATED WORK AND REQUIREMENTS

1. Section 01 31 13 Project Coordination
2. Section 01 31 19 Project Meetings
3. Section 01 31 23 Project Management Web Site
4. Section 01 91 00 Commissioning
5. Section 23 09 00 Instrumentation and Control for HVAC
6. Section 23 09 23 Direct Digital Control (DDC) System for HVAC
7. Section 23 09 93 Sequence of Operations for HVAC DDC
8. Section 26 24 13 Switchboards
9. Section 26 24 16 Panelboards

1.2 DEFINITIONS

- A. BAS - Building Automation System
- B. DHW - Domestic Hot Water
- C. M&V - Measurement and Verification
- D. kW - Electric power read from utility meter
- E. KWh - Electric energy consumption read from utility meter
- F. Plug Loads – Electric power and consumption from wall receptacles

1.3 MECHANICAL CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform M&V activities including, but not limited to, the following:
1. Follow activities identified in the M&V Plan.
 2. Coordinate connection of gas and DHW monitoring equipment with BAS.
 3. Cooperate with the M&V Provider and Controls Contractor for resolution of issues related to data collection.
 4. Attend team meetings during construction and post-construction M&V period (1 year).

1.4 ELECTRICAL CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform M&V activities including, but not limited to, the following:
1. Follow activities identified in the M&V Plan.
 2. Coordinate connection of electrical monitoring equipment with BAS

3. Cooperate with the M&V Provider and Controls Contractor for resolution of issues related to data collection.
4. Attend team meetings during construction and post-construction M&V period (1 year).

1.5 CONTROLS CONTRACTOR RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform M&V activities including, but not limited to, the following:
 1. Follow activities identified in the M&V Plan.
 2. Coordinate connection of electrical, gas, and DHW monitoring equipment with BAS
 3. Cooperate with the M&V Provider Mechanical Contractor and Electrical Contractor for resolution of issues related to establishing connection between BAS and monitoring meters and equipment.
 4. Attend team meetings during construction and post-construction M&V period (1 year).

1.6 M&V PROVIDERS RESPONSIBILITIES

- A. Providers responsibilities include:
 1. Organize and lead the M&V team.
 2. Provide M&V plan.
 3. Convene M&V meetings as needed.
 4. Cooperate with the Mechanical Contractor, Electrical Contractor, and Controls Contractor for resolution of issues related to establishing connection between BAS and monitoring meters and equipment.
 5. Provide an M&V report at 1 year post construction.

PART 2 – PRODUCTS – THIS SECTION NOT USED

2.1 METERS AND SUB-METERS

- A. Monitoring meters and sub-meters, both gas and electric, to have the ability to connect to the BAS and provide data to BAS at a minimum of 15 minute intervals. It is acceptable to use the utility for this purpose if allowable by utility company.

PART 3 - EXECUTION

3.1 METER

- A. Provide real-time monitoring of the whole building electricity kW and kWh use by using a signal from the building utility meter serving the HVAC, lighting, and plug loads and provide the data input to the Building Automation System (BAS). The BAS must be capable of trending this kW and kWh data. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the electrical contractor to coordinate this work.

3.2 SUB-METERS

- A. None are provided for this project.

3.3 NATURAL GAS

- A. Provide real-time monitoring of whole building natural gas consumption by using a signal from the building utility meter to provide the data input to the BAS. The BAS must be capable of trending gas consumption. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the mechanical contractor to coordinate this work.

3.4 DOMESTIC HOT WATER

- A. Provide real-time monitoring of the domestic hot water (DHW) system by measuring water flow to DHW heater and DHW supply and return temperatures and providing data input to the BAS. The BAS must be capable of trending gas consumption. Data is to be collected in 15 minute intervals. Storage of at least 3 months of 15 minute data is required on the BAS. Data older than 3 months is to be automatically saved and archived on the BAS computer without being overwritten. Data older than 5 years can be overwritten. It is the responsibility of the mechanical contractor to coordinate this work.

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3.5 TEMPORARY MONITORING

- A. Provide easy access to allow for the temporary installation of split-core current sensors and voltage sensors for the electrical measurement and datalogging on the following systems:
 - 1. Lighting
 - 2. Plug loads
 - 3. HVAC equipment including chillers, fans, circulation pumps, and air handling units
 - 4. DHW equipment

3.6 DDC TRENDS

- A. The Controls Contractor is to provide provision for remote access to BAS to view status of building and the ability to download trendable points.

END OF SECTION

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**SECTION 02 41 16
STRUCTURAL DEMOLITION**

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PART 1 – GENERAL

1.1. SCOPE

- 35 A. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision
36 necessary to provide for the demolition of the Mount olive Lutheran Church, adjacent single-family house,
37 adjacent structures, and such features as required in these specifications and on the drawings.
38 B. This contract includes the removal of the structure, shell, and contents. The structure consists of but is not
39 limited to the following:
40 structural frame, concrete masonry unit exterior and interior walls, interior metal stud partitions, the roof,
41 interior and exterior glass, electrical and lighting systems, mechanical systems, plumbing systems and fixtures,
42 fire protection systems, foundations, footings, slab-on-grade, and other miscellaneous items.
43 C. Pollution Control during building demolition, including noise control.
44 D. Removal and legal disposal of all demolition materials and all tipping fees paid by the demolition contractor.
45 E. Quantities shown are approximate and for bidders information on the general scope of work. This is a lump sum
46 bid, no adjustments will be made on unit prices for differences in quantities or conditions shown.
47 F. The scope includes complying with the reuse & recycling plans prepared by Madison Environmental Group and
48 Wastecap. Other building materials will need to be removed prior to demolition per the reuse & recycling plans.
49 1. This will also include pre-notification, prior to removal, to the City Construction Manager (CCM) listing the
50 intended destination for these materials.
51 G. The work includes the coordination and removal of any remaining overhead utility lines to the church and the
52 parsonage.
53 H. Prior to bidding, thoroughly inspect existing conditions.

1.2. RELATED REQUIREMENTS

- 57 A. Section 01 26 57 – Change Order Requests
58 B. Section 01 31 19 – Project Meetings

- 1 C. Section 01 31 23 – Project Management Web Site
- 2 E. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials;
3 requirements for recycling
- 4 F. Section 01 76 00 – Protecting Installed Construction
- 5 G. 31 05 10 - Site Preparation.
- 6 H. A&A Environmental, Inc Inspection Report Dated February 8, 2014.
- 7 I. 4016 Madison Environmental Group Deconstruction Reuse & Recycling Plan Dated June 1, 2015.
- 8 J. 4018 Madison Environmental Group Deconstruction Reuse & Recycling Plan Dated October 3, 2014.
- 9

10 **1.3. REFERENCE STANDARDS**

- 11 A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- 12 B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2009.
- 13

14 **1.4. DEFINITIONS**

- 15 A. Remove: Detach items from existing construction and legally dispose of them off-site.
- 16

17 **1.5. MATERIALS OWNERSHIP**

- 18 A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- 19 B. On-site storage or sale of removed items or materials is not permitted.
- 20

21 **1.6. SUBMITTALS**

- 22 A. For utilities or other services requiring removal or abandonment in-place, submit materials documenting
23 completion of such work.
- 24 B. Schedule: Submit for approval the structural demolition schedule.
- 25 B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface
26 construction.
- 27 D. Submit copies of records documenting recycling or disposal of demolition materials from the site.
- 28

29 **1.7. PRE-DEMOLITION MEETINGS**

- 30 A. Convene minimum two weeks prior to starting any structural demolition.
- 31

32 **1.8. PROJECT CONDITIONS**

- 33 A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
- 34 B. Owner assumes no responsibility for buildings and structures to be demolished.
- 35 C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- 36 D. The Owner will remove and salvage items prior to inspection for bidding purposes.
- 37

38 **1.9. QUALITY ASSURANCE**

- 39 A. Codes and Regulations: Comply with all governing codes and regulations. Use experienced workers.
- 40 B. Comply with governing EPA notification regulations before beginning demolition.
- 41 C. Comply with hauling and disposal regulations of authorities having jurisdiction.
- 42 D. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.
- 43

44 **1.10. HAZARDOUS MATERIALS**

- 45 A. Hazardous materials have been removed under prior separate contract. A report on the presence of hazardous
46 materials is included in the Asbestos Abatement specification and is available for review and use. Examine report
47 to become aware of locations where hazardous materials are present.
- 48 B. If hazardous materials are not anticipated, but encountered, terminate operations and contact the City
49 Construction Manager immediately. Follow all applicable local, state and federal regulations pertaining to
50 hazardous materials.
- 51 C. Do not disturb hazardous materials or items suspected of containing hazardous materials except under
52 procedures specified elsewhere in the Contract Documents.
- 53 D. Hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- 54

55 **1.11. SAFETY**

- 56 A. Verify that all gas and electrical utilities have been abandoned or disconnected and associated hazards mitigated,
57 prior to beginning any demolition.

- 1 B. Take all necessary precautions while dismantling piping containing gas, gasoline, oil or other explosive or toxic
2 fluids or gases. Purge lines and contain materials in accordance with all applicable regulations. Store such piping
3 outdoors until fumes are removed.
4 C. Maintain a clean and orderly site. Remove debris at end of each workday.
5 D. Burning of debris is not permitted.
6

7 **1.12. PERMITS**

- 8 A. Unless otherwise noted, Contractor shall be responsible for obtaining and paying for all permits necessary to
9 complete demolition work.
10 • Madison General Ordinance 28.185 (7)(a)5 requires approval of a reuse and recycling plan by the Recycling
11 Coordinator, Bryan Johnson (608-267-2626), prior to the issuance of the demolition permit. GC to
12 coordinate with the CCM to assure compliance with the prepared reuse & recycling plans.
13 • Madison General Ordinance 28.185 (10) requires everyone who is required to submit a reuse and recycling
14 plan per MGO 28.185 (7)(a)5 shall submit documents showing compliance with the plan within sixty days of
15 demolition completion. GC to coordinate with the CCM to assure compliance with the prepared reuse &
16 recycling plans.
17 B. If necessary, file and maintain Notification of Demolition and/or Renovation and Application for Permit
18 Exemption (WDNR Form 4500-113) in accordance with the Wisconsin Administrative Code Chapter NR447.
19

20 **1.13. DISCONNECTION OF SERVICES**

- 21 A. Prior to starting removal and/or demolition operations be responsible and coordinate disconnection of all
22 existing utilities, communication systems, alarm systems and other services.
23 B. Disconnect all services in manner which insures continued operation in facilities not scheduled for demolition.
24 C. Disconnect all services in manner which allows for future connection to that service.
25 D. Disconnect services to equipment at unions, flanges, valves, or fittings wherever possible.
26

27 **PART 2 - PRODUCTS**

28
29 **2.1. MATERIALS**

- 30 A. Use Contractor's normal equipment for demolition purposes and which meets all safety requirements imposed on
31 such equipment.
32

33 **PART 3 - EXECUTION**

34
35 **3.1. EXAMINATION**

- 36 A. Demolition Drawings are based on casual field observation and/or existing documents. Report discrepancies to
37 the City Construction Manager before disturbing existing installation.
38 B. Verify that construction and utility arrangements are as shown.
39 C. Verify that abandoned wiring and equipment serve only abandoned facilities.
40 D. Verify that utilities have been disconnected and capped before starting demolition operations.
41 E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
42 F. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon
43 examination prior to starting demolition.
44

45 **3.2. PREPARATION**

- 46 A. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve
47 stability and prevent unexpected movement or collapse of construction being demolished.
48 B. Strengthen or add new supports when required during progress of demolition.
49 C. Disconnect electrical systems in walls, floors, and ceilings. Contractor is responsible for disconnecting the
50 electrical feed to the project site. Demolition cannot begin until the contractor has completed the temporary
51 electric connection.
52 D. Coordinate utility service outages with the City Construction Manager. Also, if applicable, coordinate utility
53 service outages with the local Utility Company.
54 E. Provide temporary wiring and connections to maintain temporary systems during demolition. When work must
55 be performed on energized equipment or circuits, use personnel experienced in such operations.
56

1 **3.3. PROTECTION OF EXISTING WORK AND FACILITIES**

- 2 A. Take all measures necessary to safeguard all existing work and facilities which are outside the limits of the work.
- 3 B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
- 4 C. Do not interrupt existing utilities serving adjacent occupied or operating facilities. Provide temporary services
- 5 during interruptions to existing utilities.
- 6 D. Furnish and install fencing or other barriers as shown on the plans or as otherwise necessary to protect existing
- 7 features.
- 8 E. Verify the locations of, and protect, any structures, utilities, paved surfaces, signs, streetlights, utilities,
- 9 landscaping and all other such facilities that are intended to remain or be salvaged.
- 10 F. Make such explorations and probes as necessary to ascertain any required protection measures that shall be
- 11 used before proceeding with demolition.
- 12 G. Provide and maintain adequate catch platforms, warning lights, barricades, guards, weather protection, dust
- 13 protection, fences, planking, bracing, shoring, piling, signs, and other items required for proper protection.
- 14 H. Provide protection for workmen, public, adjacent construction and occupants of existing building(s).
- 15 I. Report damage of any facilities or items scheduled for salvaging to the City Construction Manager.
- 16 J. Repair or replace any damaged facilities that are not scheduled for demolition.
- 17 K. Explosives shall not be used for demolition.
- 18 L. Keep streets, walks and all other adjacent paved areas clean and swept clear of dirt, mud and debris deposited as
- 19 a result of this operation.
- 20 M. Protect surrounding area from dust. Control rodents, and other vermin associated with demolition operations.

21
22 **3.4. DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK**

- 23 A. Demolish and extend existing electrical work to meet all requirements of these specifications.
- 24 B. Extend existing installations using materials and methods compatible with existing electrical installations, or as
- 25 specified.

26
27 **3.5. DEMOLITION**

- 28 A. Remove all equipment, fixtures and other materials scheduled for salvage prior to beginning demolition
- 29 operations.
- 30 B. Demolish and remove all buildings and structures scheduled for demolition as noted and/or as shown on the
- 31 plans.
- 32 C. Abandon gas, electric and communication utilities in accordance with local utility company requirements, or
- 33 applicable substantive requirements if considered private.
- 34 D. Carry out vehicle loading as necessary within the project boundaries or as defined or indicated on the drawings,
- 35 but not in locations that block vehicular traffic on the streets or pedestrian traffic on adjacent public walks.
- 36 E. Dismantle each structure in an orderly manner to provide complete stability of the structure at all times.
- 37 F. Conduct demolition operations and the removal of rubbish and debris in such a way that a minimum of nuisance
- 38 dust is caused. Constantly sprinkle rubbish and debris with water if necessary to keep nuisance dust to a
- 39 minimum.
- 40 G. Where necessary to prevent collapse of any construction, install temporary shores, underpinning, struts or
- 41 bracing. Do not commence demolition work until all temporary construction is complete.
- 42 H. During the execution of the work, provide, operate, and maintain all pumping equipment, suction and discharge
- 43 lines in a number of capacity as required to keep all cellars and pits free of water from any source whatsoever at
- 44 all times.
- 45 I. Operate equipment so as to keep dust and dirt to a minimum.
- 46 J. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure
- 47 minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 48 K. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without
- 49 permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed
- 50 traffic ways if required by authorities having jurisdiction.
- 51 L. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing
- 52 environmental-protection regulations. Do not use water when it may damage adjacent construction or create
- 53 hazardous or objectionable conditions, such as ice, flooding, and pollution.
- 54 M. Remove existing walks, drives, and curbs as indicated within site work limits. Sawcut adjacent asphaltic and

1 concrete pavements that are to be left in place to provide a smooth straight joint.
2

3 **3.6. BUILDING DEMOLITION**

- 4 A. Proceed with demolition in a systematic manner, from top of structure to ground. Complete demolition work
5 above each floor or tier before disturbing supporting members on lower levels.
6 B. Locate demolition equipment and remove structure so as to not impose excessive loads to supporting walls,
7 floors or framing.
8

9 **3.7. DEMOLITION BELOW GRADE**

- 10 A. Demolish foundation walls and other below grade features as noted or in accordance with the plans. Unless
11 otherwise noted, remove all below grade features and properly dispose of off site.
12

13 **3.7. DEMOLITION BACKFILL**

- 14 A. Backfill and compact below grade areas and voids resulting from demolition of structures and other
15 abandonment and demolition.
16 B. Backfilling shall not begin until demolition and abandonment has been approved and documented by the CCM
17 Construction Representative.
18 C. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen
19 materials, trash and debris.
20 D. Backfill type, lift thickness and compaction requirements shall be in accordance with Section 31 20 00 –
21 Earthmoving.
22

23 **3.8. TRANSPORTATION AND DISPOSAL OF DEMOLITION WASTE**

- 24 A. Transport and dispose all demolition waste in accordance with local, state, and federal guidelines.
25 B. Whenever possible, or otherwise required by the Contract Documents, recycle demolition waste.
26 C. Demolition waste shall be disposed of at a landfill or dumpsite designed and approved to accept the given waste.
27 D. Maintain records documenting recycling and disposal of demolition waste. Record description of material, date
28 removed, quantity removed, method of transport and recycling/disposal destination for submittal to the City.
29

30 **3.9. CLEANING**

- 31 A. Keep streets, walks and all other adjacent paved areas clean and swept clear of dirt, mud and debris deposited
32 as a result of this operation.
33 B. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations.
34 Return adjacent areas to condition existing before building demolition operations began.
35 C. Clean roadways of debris caused by debris transport.
36 D. Clean up spillage and windblown debris from public and private lands.
37 E. Leave site in clean condition that is ready to accept subsequent work.
38

39
40 **END OF SECTION**
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SECTION 03 10 00 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section includes the design, construction and treatment of formwork and related accessories to confine and shape concrete to the required dimensions.
- C. This section also includes the installation of embedded items such as waterstops, dovetail anchors, flashing reglets, shelf angles, and PVC weeps.
- D. Structural notes indicated on the drawings regarding concrete formwork shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.
 - 1. ACI 117 – Standard Specification for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 – Standard Specification for Structural Concrete.
 - 3. ACI 318 – Building Code Requirements for Structural Concrete.
 - 4. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
 - 5. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Test Specimens.
- B. Where provisions of the pertinent Codes and Standards conflict with this specification, the more stringent provision shall govern.
- C. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 - 1. Non-rented temporary concrete formwork.

1.3 TESTING AND INSPECTION

- A. Inspection and Testing:
 - 1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
 - 2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
 - 3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:
- a. Perform all testing and inspection required per the Testing and Inspection Schedule indicated below.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.
5. Structural Component Testing and Inspection Schedule for Section 03 10 00 is as follows:

	Continuous	Periodic	Referenced Standard
Concrete and Concrete Placement			
Inspect formwork for shape, location and dimensions of the concrete member being formed.		X	ACI 318: 6.1.1

1.4 SUBMITTALS

- A. Formwork Release Agent: Submit data on the formwork release agent proposed for use with each form surface to be used for acceptance unless otherwise specified in the Contract Documents. Include certification that agent is compatible with finish.
- B. Product Data: Submit manufacturer's product data for all waterstop profiles supplied for the concrete construction.
- C. Testing for Formwork Removal: When methods other than cylinder tests are proposed for determining time for formwork removal, submit data on methods for approval.
- D. LEED Certification: Submit manufacturer's certification for formwork including the following:
 1. LEED Credit MRc 4.2 – Recycled content including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.
 2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.
 3. LEED Credit MRc 7 – Chain-of-custody certificates certifying that wood used for formwork complies with forest certification requirements. Include evidence that manufacturer is certified for chain-of-custody by an FSC-accredited certification body.
 - a. Include statement indicating costs for each certified wood product.

1.5 DESIGN REQUIREMENTS

- A. Design and Engineering of formwork is the responsibility of the Contractor. Design and construct formwork, shoring and bracing to conform to Contract Documents and building code requirements. Design for construction loads, lateral pressure, and requirements of the applicable building code.

-
- B. Drawings show the design requirements and dimensions for structural strength, but structural drawings do not show all detail dimensions to fit intricate Architectural and mechanical detail. Contractor shall so construct the concrete work that it will conform to the clearance required by the Architectural, Mechanical and Electrical design.
 - C. Maximum deflection of facing materials forming concrete surfaces exposed to view shall be 1/240 of the center-to-center span between structural members of the formwork.

PART 2 - PRODUCTS

2.1 MATERIALS AND ACCESSORIES

- A. Formwork Accessories: Use commercially manufactured accessories for formwork accessories that are partially or completely embedded in concrete, including ties and hangers.
- B. Formwork Release Agent: Use commercially manufactured form release agents that will prevent formwork absorption of moisture, prevent bond with concrete, and will not stain the concrete surface. Formwork release agent shall be compatible with paint or any other finish applied to the concrete; submit data indicating compatibility.
- C. Waterstops: Waterstops shall be a flexible butyl rubber and bentonite clay compound that swells upon contact with water. Acceptable manufacturer's and products:
 - 1. CETCO – Waterstop RX
 - 2. Greenstreak – Swellstop
 - 3. J.P. Specialties – Earth Shield (Type 20 & 23) Waterstop
- D. Form Material:
 - 1. No aluminum shall be allowed in the concrete work unless coated to prevent aluminum-concrete reaction.
 - 2. Concrete form materials must be used in a manner so as to provide the surface finish specified.
 - 3. Design formwork in accordance with the provisions of the building code or the following standards if not covered in the building code:
 - a. Wood - AF & PA "National Design Specification".
 - b. Plywood - American Plywood Association "Plywood Design Specification".
 - c. Steel - AISC "Manual of Steel Construction - Allowable Stress Design".
 - d. Cold-formed Steel - AISI "Cold-Formed Steel Design Manual".
 - e. Aluminum - Aluminum Association "Aluminum Construction Manual".
 - f. Concrete - ACI 318.
 - g. Other materials - as directed by manufacturer.
- E. Chamfer Strips:
 - 1. Chamfer strips shall be 3/4 inch by 3/4 inch strips. Verify material finish with Architect.
- F. Keyways:
 - 1. Provide keyways as shown on the Drawings. Unless noted otherwise, keyways shall be a minimum of 1-1/2 inches deep and 3-1/2 inches wide. Bevel edges of keyways 10 degrees to facilitate stripping.

2.2 FORM FINISHES

A. Rough Form Finish:

1. Concrete surfaces not exposed to view in the finished work shall have a rough-form finish. No form-facing material is specified for rough-form finish.
2. Set and maintain forms so finished concrete dimensions shall conform to the tolerances. Rough form finish is Designated Surface Finish-1.0 from ACI 301, except that surface tolerance Class C is required as specified in ACI 117.

B. Smooth Form Finish:

1. Concrete surfaces exposed to view in the finished work or surfaces to receive finishes of any type (paint, textured paint, etc.) shall have a smooth form finish. Form-facing material shall be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other acceptable material capable of producing the desired finish. Form-facing material shall produce a smooth, uniform texture on the concrete. Do not use form facing material with raised grain, torn surfaces, worn edges, patches, dents, or other defects that might impair the texture of the concrete surfaces.
2. Set and maintain forms so finished concrete dimensions shall conform to the tolerances. Smooth form finish is Designated Surface Finish-3.0 from ACI 301, including surface tolerance Class A as specified in ACI 117.

C. Patching and repairing concrete finishes are specified under Section 03 30 00.

2.3 FABRICATION AND MANUFACTURE

A. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of the exposed concrete surface.
2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

B. Waterstops: Fabricate pieces of premolded waterstop with a maximum practicable length to hold the number of end joints to a minimum. Fabricate joints in waterstops in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 CONSTRUCTION OF TEMPORARY FORMWORK

- A. Design, erect, shore, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
- B. At construction joints, lap contact surface of the form sheathing for flush surfaces exposed to view over the hardened concrete in the previous placement by not more than 1 inch. Ensure formwork is held firmly against hardened concrete to prevent offsets or loss of mortar at construction joints and to maintain a true surface.

-
- C. Unless specified in the Contract Documents, construct formwork so concrete surfaces conform to tolerance limits. The class of surface for offset between adjacent pieces of formwork facing material shall be Class C, unless specified otherwise.
 - D. Provide positive means of adjustment (wedges or jacks) of shores and struts. Do not make adjustments in the formwork after concrete has taken its initial set. Brace formwork securely against lateral deflection and lateral instability.
 - E. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete. Formwork camber calculations are the responsibility of the formwork designer. Set formwork and intermediate screed strips for slabs accurately to produce designated elevations and contours of the finished surface prior to removal of formwork. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds when the finish specified requires the use of such equipment.
 - F. When formwork is cambered, set screeds to a like camber to maintain required concrete thickness.
 - G. Fasten form wedges in place after final adjustment of forms and prior to concrete placement.
 - H. Anchor formwork to shores, supporting surfaces, or members to prevent upward or lateral movement of the formwork system during concrete placement.
 - I. Securely brace and shore forms to prevent displacement and to safely support construction loads.
 - J. Construct formwork for wall openings to facilitate removal and to counteract swelling of wood formwork. Keep wood forms wet as necessary to prevent shrinkage.
 - K. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Chamfer wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 - L. Do not use rust-stained steel form-facing material.
 - M. Provide temporary openings at the base of column and wall formwork and at other points where necessary to facilitate cleaning and inspection.
 - N. Unless noted otherwise, all footings shall be centered under walls, piers or columns.
 - O. Provide runways for moving equipment and support runways directly on formwork or structural member without resting on the reinforcing steel.
 - P. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for support of adjoining work prior to concrete placement.
 - Q. Position and support expansion joint material and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
 - R. Projecting corners of beams, walls and columns shall be formed with a 3/4 inch chamfer. Unless noted otherwise on Architectural drawings.
 - S. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign material before concrete is placed.

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- T. Cover surfaces of formwork with acceptable formwork release agent. Apply form release agent before placing reinforcing steel and concrete according to manufacturer's written instructions. Do not allow formwork release agent to puddle in forms. Do not allow formwork release agent to contact reinforcing steel or hardened concrete against which fresh concrete is to be placed
 - U. Clean and inspect formwork immediately before concrete is placed.
 - V. Provide forms for concrete work adjacent to earth banks including sides of footings, except where footing excavation is vertical rock cut.
 - W. Construct forms plumb and straight to conform to slopes, lines and dimensions shown.
 - X. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

3.2 COORDINATION

- A. Install all required pipe sleeves, cavities or slots. Notify appropriate trades in due time so that they may furnish information and make necessary installations. Check sizes, location and alignment of all openings, frames and other work, which are to be built-in including electrical boxes and conduit.
- B. Layout the run of partitions and establish location of openings so that other trades may properly locate their work.
- C. Core drilling concrete is not permitted unless noted otherwise or approved in writing by the Architect. Notify the Architect in advance of conditions not shown on the drawings.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Built-In Items:

1. Confirm with Architect that all materials to be embedded are suitable for embedment in concrete.
2. Build in anchors, inserts, and other devices indicated or required for various portions of work.
3. Build in sleeves, thimbles, and other items furnished or set in place by other trades.
4. Accurately position and support all embedded items prior to concrete placement. Secure embedded items against displacement during concrete placement operations.
5. Fill voids with readily removable material to prevent entry of concrete into voids.
6. Mechanical and electrical shall provide and set required sleeves.
7. Coordinate setting of all embedded items.

B. Waterstops:

1. Locate waterstops in joints where indicated on the Drawings.
2. Build in waterstops using longest unbroken lengths possible to hold the number of end splices to a minimum.
3. Form splices and intersections strictly according to the manufacturer's instructions so that waterstops are continuous and develop effective watertight joint.

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4. Locate waterstops as shown on the Drawings. In general, waterstops should be located just behind outermost layer of reinforcing. Do not place waterstops closer than 2" from face of concrete.

3.4 REMOVAL OF FORMS

- A. When removal of formwork is based on concrete reaching a specified compressive strength, concrete will be presumed to have reached this strength when either of the following requirements has been met:
 1. Test cylinders, molded and cured under the same conditions for moisture and temperature as used for the concrete they represent, have reached the specified compressive strength.
 2. Concrete has been cured in accordance with the specifications for the same length of time as laboratory-cured cylinders, which have reached the specified strength. Determine the length of time concrete has been cured in the structure by the cumulative number of days or fractions thereof, not necessarily consecutive, during which the temperature of the air in contact with the concrete is above 50 degrees and the concrete has been damp or thoroughly sealed from evaporation and loss of moisture.
- B. Forms shall remain in place for the following periods of time. These periods represent cumulative number days or hours, not necessarily consecutive, during which the temperature of the air surrounding the concrete is above 50 F:
 1. Walls, grade beams, columns, sides of beams, girders and footings: 50% specified compressive strength or minimum 24 hours.
- C. When finishing is required, remove forms as soon as removal operations will not damage concrete.
- D. Loosen wood formwork for wall openings when this can be accomplished without causing damage to concrete.
- E. Do not allow removal of formwork to damage the fresh concrete for columns, walls, sides of beams, and other parts supporting the weight of the concrete. Perform needed repair and treatment required on vertical surfaces at once and follow immediately with specified curing.

3.5 FASTENER REMOVAL

- A. Remove all protruding fasteners left as a result of securing inserts to forms by Contractor responsible for insert.
- B. Cutting flush with surface is not acceptable.
- C. Patch exposed concrete surfaces if damaged during fastener removal process.

3.6 REMOVING AND REUSING FORMS

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- B. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

END OF SECTION 03 10 00

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SECTION 03 20 00 - CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section includes the fabrication and placement of reinforcing steel for concrete, and all related accessories.
- C. Reinforcing steel for use in bond beams, masonry columns, and lintels is specified in Division 4 and is not a part of the work in this section.
- D. Structural notes indicated on the drawings regarding concrete reinforcement shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Standard Specification for Structural Concrete.
 - 3. ACI 318 - Building Code Requirements for Structural Concrete.
 - 4. ACI 315 - Details and Detailing of Concrete Reinforcement.
 - 5. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 6. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 7. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - 8. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 9. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete.
 - 10. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
 - 11. CRSI - Manual of Standard Practice.
- B. Where provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1.3 TESTING AND INSPECTION

- A. Inspection and Testing:
 - 1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.

2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.
4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per the Testing and Inspection Schedule indicated below.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.
5. Structural Component Testing and Inspection Schedule for Section 03 20 00 is as follows:

	Continuous	Periodic	
Concrete and Concrete Placement			Referenced Standard
Inspection of fabricators and during fabrication.		X	
Inspection of reinforcing steel and placement.		X	ACI 318: 3.5, 7.1-7.7
Inspection of reinforcing steel welding:			
A. Verification of weldability of reinforcing steel other than ASTM A706.		X	AWS D1.4, ACI 318: 3.5.2
B. Shear reinforcement.	X		
C. Other reinforcing steel.		X	

1.4 SUBMITTALS

- A. Placing Drawings: Submit placing drawings showing fabrication dimensions and locations for placement of reinforcement and reinforcement accessories. Indicate bar sizes, spacing, locations, and quantities of reinforcing steel, bending and cutting diagrams, and supporting and spacing devices. Dowels shall be shown in placing drawings for the element that is to be placed first. Reinforcing steel descriptions or shop drawings shall be inch-pound sizes.
- B. Product Data: Submit product data sheets for all specified products.
 1. Fibrous concrete reinforcing material.
 - a. Application rate per cubic yard of concrete.
 - b. Manufacturer's printed batching and mixing instructions.
 - c. Letter of Certification that materials supplied meets or exceeds ASTM C1116.
- C. Manufacturer's Certificate: Submit mill certifications at time of delivery.
- D. Splices: Submit request for splices not indicated in the Contract Documents. Request shall indicate locations, types, and lengths of splices for approval.

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- E. Field Bending: Submit requests and procedure for field bending or straightening of reinforcement partially embedded in concrete not described in the Contract Documents.
 - F. Reinforcement Relocation: Submit requests to adjust reinforcement spacing necessitated by conflicts with other reinforcement, conduits, etc. for approval.
 - G. Mechanical Connections: Submit request for the use of mechanical connections not shown on the Project Drawings. Include engineering data on proprietary connection devices for approval.
 - H. Welding: Submit description of reinforcement weld locations, welding procedures, and welding certificates for personnel conducting the welding.
 - I. Alternative Reinforcement: Submit request to relocate any reinforcing bars that exceeds placement tolerances.
 - J. LEED Certification: Submit manufacturer's certification for reinforcement including the following:
 - 1. LEED Credit MRc 4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost, and steel processing furnace type.
 - 2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.5 COORDINATION

- A. Coordinate reinforcement installation with the placement of formwork and other embedded items such as inserts, conduit, pipe sleeves, drains, metal supports, anchor rods, etc.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver reinforcement to the jobsite in bundles sorted and labeled with durable tags indicating bar size, length, and shop drawing mark.
- B. Store elevated clear of ground and protect at all times from contamination and deterioration.
- C. Prevent bending, coating with earth, oil, or other material, or otherwise damaging the reinforcement.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bar Deformations: Bars used for reinforcement shall be deformed except column spirals and welded wire reinforcement, which may be plain.
- B. Reinforcing Steel: Reinforcing steel shall conform to the ASTM standard and grade indicated in the General Notes on the Drawings.
- C. Micro Fiber Reinforcing: 100% virgin polypropylene, MD grade, fibers containing no reprocessed olefin materials and specifically manufactured for use as concrete secondary reinforcement.
 - 1. Fiber length: Multi-Design Gradation Fibrillated Fibers
 - 2. Mix proprietary materials in accordance with manufacturer's instructions, product data and technical bulletins.

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3. Application Rate: 1 to 1-1/2 lbs. per cubic yard or as recommended by the fiber-reinforcing manufacturer.
 - a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Fibrasol F; Axim Concrete Technologies.
 - 2) Fibermesh; Fibermesh, Div. of Synthetic Industries.
 - 3) Forta; Forta Corporation.
 - 4) Grace Fibers; W. R. Grace & Co., Construction Products Div.
 - D. Welded Wire Reinforcement: Welded wire reinforcement shall conform to the ASTM standard indicated in the General Notes on the Drawings.
 - E. Joint Dowel Bars: Plain-steel bars. Cut bars true to length with square ends and free of burrs.
 - F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
 2. Concrete cast against earth: Bars may be supported by precast concrete bricks or approved prefabricated wire bar supports with footpads large enough to support the weight of the bars and construction traffic without being pushed into underlying grade. Precast concrete blocks shall have a minimum compressive strength of 6,000 psi.
 - G. Epoxy Anchoring System: Epoxy anchoring shall consist of a reinforcing dowel and the epoxy adhesive cartridge.
 1. Reinforcing shall be as specified earlier in this Section.
 2. Epoxy injection gel shall consist of a two-component structural epoxy adhesive applied in a dual cartridge dispensing system, which properly mixes the components at the point of application. Refer to General Notes for acceptable epoxy anchoring systems.

2.2 FABRICATION

- A. Fabrication Tolerances: Reinforcing steel shall be shop fabricated within tolerances to conform in size, shape, quantity, dimensions, etc. to the Construction Drawings and approved Shop Drawings.
- B. Bar Condition: Bars shall be free from mill scale, excessive rust and other coatings, which would reduce or destroy the bond with the concrete.
- C. Bars Bending: Bars shall be bent cold, and no method of fabrication shall be used which would be injurious to the material. Heating of bars for bending is not permitted.
- D. Identification: After fabrication, bars shall be sorted, bundled and tagged with metal tags bearing the bar mark before delivery to the jobsite.
- E. Corner Bars: Provide corner bars to make reinforcing continuous at all times, including intersections at footings, walls, beams or caps. Such bars shall be the same size and spacing as the horizontal reinforcing and each leg shall have a length of at least 30 inches.

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- F. Continuous reinforcing in beams and grade beams shall be lapped as follows unless noted otherwise:
- | | | |
|----|-------------|-----------------------|
| 1. | Top bars | Midspan |
| 2. | Bottom bars | Directly over support |
- G. Where beams and grade beams are simple span, top bars shall be continuous for full length and hooked down at each end.
- H. Reinforcing for continuous footings shall extend into spread footings a minimum of 2'-0".
- I. Dowels between footings and walls or columns shall be the same grade, size and spacing or number as the vertical reinforcing respectively, unless noted otherwise.
- J. Welding: Do not weld crossing bars (tack welding) for assembly of reinforcement, supports, or embedded items.

2.3 LEED CREDIT

- A. LEED Credit MRc 4.2:
1. Provide steel products made using an Electric Arc Furnace having a minimum recycled content of 80%, including at least 40% post-consumer recycled content and 30% post-industrial recycled content.
 2. Provide steel products made using a Basic Oxygen Furnace having a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.
- B. LEED Credit MRc 5.1/5.2:
1. Steel products shall be manufactured within 500 miles of project site. Recycled steel products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 PLACING

- A. Reinforcement Relocation: When necessary to move reinforcement beyond the specified spacing to avoid interference with other reinforcement, or embedded items, submit resulting arrangement of reinforcement to Engineer for approval.
- B. Reinforcement Cutting: Cutting of reinforcement which conflicts with embedded objects is not acceptable.
- C. Welded Wire Reinforcement: Extend welded wire reinforcement to within 1 inch of the concrete edge. Lap edges and ends of fabric sheets a minimum of one full mesh square plus 2". Support welded wire reinforcement during placing of concrete to assure required positioning in the slab. Do not place wire reinforcement on grade or metal deck and raise into position in freshly-placed concrete.
- D. Wire Tie Orientation: Set wire ties so that ends are directed away from concrete surface.
- E. Slab on Grade Reinforcement Placement: Place shrinkage and temperature reinforcement 2 inches from the top surface of the slabs on grade unless noted otherwise on the Drawings.
- F. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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- G. Support for Reinforcement: Unless noted otherwise, supports for reinforcement shall have Class 2 protection as defined in the CRSI Manual of Standard Practice. Submit data on supports indicating class of protection at all different locations for approval.
 - H. Fibrous Reinforcement: Add fibrous reinforcement to concrete materials at the time concrete is batched in amounts indicated on the approved submittals for each type of concrete required.
 - 1. Mix concrete for uniform and complete distribution of fibrous reinforcement.
 - I. Support for Bars in Concrete Cast on Ground: Bar supports for slabs on grade, grade beams, footings, and all other concrete cast directly onto grade shall be supported at an average spacing of 4 feet or less in each direction.
 - J. Securing Reinforcing Bars: All bars must be placed, spaced, secured and supported prior to casting concrete. Bars embedded in hardened or partially hardened concrete shall not be bent unless approved in writing prior to placement by the Engineer of Record.
 - K. Foot Traffic: Restrict foot traffic over the slab on grade reinforcing after it has been properly positioned.
 - L. Reinforcement at Expansion Joints: Do not continue reinforcement or other embedded metal items bonded to concrete through expansion joints. Dowels bonded on only one side of a joint and waterstops may extend through joint.
 - M. Pumping Concrete: When using a pump to place concrete, pump hose shall be supported directly on forms. Do not allow hose to rest on reinforcing bars if doing so could cause displacement of bars.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. The work includes all items required for executing and completing the cast-in-place concrete work and related work shown on the drawings or specified herein. Work shall include installation of items furnished in other sections of these specifications.
- C. Concrete paving, walks and curbs are specified in Division 3 or 32.
- D. Structural notes indicated on the drawings regarding Cast-In-Place concrete shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified herein:
 - 1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 - Standard Specifications for Structural Concrete
 - 3. ACI 305.1 - Specification for Hot Weather Concreting
 - 4. ACI 306.1 - Standard Specification for Cold-Weather Concrete
 - 5. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 6. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 7. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 8. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 9. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 10. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 11. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 12. ASTM C150 - Standard Specification for Portland Cement.
 - 13. ASTM C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete
 - 14. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 15. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
 - 16. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

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17. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 18. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 19. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 20. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 21. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
 22. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 23. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
 24. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
 25. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
 26. ASTM E154 - Standard Test Method for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
 27. ASTM E329 –Standard Specification for Agencies Engaged in Testing and/or Inspection of Material Used in Construction
 28. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.
- B. Comply with all local building code requirements which are more stringent than those listed above. All referenced codes or standards shall be the most currently adopted as of the date for Receipt of Proposal.
 - C. Where any provision of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
 - D. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the requirements of the Contract Documents.
 - E. Use of testing services will not relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.

1.3 TESTING AND INSPECTION

- A. Inspection and Testing:
 1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
 2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
 3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.

4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per the Testing and Inspection Schedule indicated below.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 03 30 00 is as follows:

	Continuous	Periodic	Referenced Standard
Concrete and Concrete Placement			
Review of proposed mix design and supporting test results		X	
Inspect bolts to be installed in concrete prior to and during placement of concrete where allowable loads have been increased or where strength design is used.	X		ACI 318: 8.1.3, 21.2.8
Inspection of anchors installed in hardened concrete.		X	ACI 318: 3.8.6, 8.1.3, 21.1.8
Verifying use of required design mix		X	ACI 318: Ch. 4, 5.2-5.4
At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	X		ASTM C172, ASTM C31, ACI 318: 5.6, 5.8
Inspection of concrete placement for proper application techniques	X		ACI 318: 5.9, 5.10
Inspection for maintenance of specified curing temperature and techniques.		X	ACI 318: 5.11 - 5.13
Verification of in-situ concrete strength prior to removal of shores and forms from beams and structural slabs		X	ACI 318: 6.2
Wet unit weight testing			

- B. Sampling and testing requirements:
 1. Take samples of fresh concrete at the job site for each mix design placed each day. Sampling and testing shall be done after the final addition and proper mixing of any water or admixtures that are added on site.
 - a. Personnel and testing equipment shall meet the requirements of ASTM E329.
 - b. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

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- 1) On a given project, if the total volume of concrete is such that the frequency of testing required above would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
 - c. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days.
 2. For each sample of fresh concrete, perform the following duties:
 - a. Measure and record slump in accordance with ASTM C143.
 - b. Measure and record temperature in accordance with ASTM C1064.
 - 1) Provide one test hourly when air temperature is 40°F (4.4°C) and below and when 80°F (27°C) and above, and one test for each composite sample.
 - c. Measure and record air content by volume in accordance with either ASTM C231 or ASTM C173.
 - d. Measure and record shrinkage percentage in accordance with ASTM C157, with the following modifications:
 - 1) Wet cure specimens for a period of seven (7) days (including the period of time the specimens are in the mold). Wet cure may be achieved through storage in a moist cabinet or room in accordance with ASTM C511, or through storage in lime-saturated water.
 - 2) Slump of concrete for testing shall match job requirements and need not be limited to the restrictions as stated in ASTM C157.
 - 3) Report results in accordance with ASTM C157 at 0, 7, 14 and 28 days of drying.
 - e. Mold three cylinders (laboratory cylinders) in accordance with ASTM C31 to be laboratory-cured. Protect from moisture loss and maintain at 60°F to 80°F for 24 to 48 hours before moving. Deliver cylinders to testing laboratory for curing and testing.
 - f. Mold one cylinder (field cylinder) in accordance with ASTM C31 to be field-cured. Field cylinder shall be placed as near as possible to the in-place concrete from which it was taken, protected, and cured in the same manner. Deliver field-cured cylinder to testing laboratory, and measure and record compressive strength in accordance with ASTM C39. Field cylinder shall be used to determine if concrete footings, walls, or piers have reached the required compressive strength for steel erection to begin.
 3. Measure and record compressive strength in accordance with ASTM C39 for laboratory cylinders. Test one laboratory cylinder at 7 days and all other cylinders at 28 days. Acceptance is based on the average of the two laboratory cured 28-day tests. Notify Architect in the event strength levels do not meet the acceptance requirements of ACI 318.
 - a. Any additional cylinders molded for Contractor to have a compressive strength test done before seven days shall be at the Contractor's expense.
 4. Prepare and submit test reports to the Architect, Engineer, Contractor, and Supplier. Reports shall be completed and furnished within 48 hours of testing. Refer to description in Submittals.
 5. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

1.4 SUBMITTALS

- A. Concrete Materials: Submit information on concrete materials as listed below.
1. Cementitious materials: Submit type, class, producer name, and certification not more than 90 days old of compliance with applicable ASTM standard.
 2. Aggregates: Submit type, pit or quarry location, producer name, gradations, specific gravity, water content, and certification not more than 90 days old.
 3. Admixtures: Submit product data sheet. Product data shall include: dosages and performance data, brand names, producers, chloride ion concentrations, and certifications of compliance with applicable ASTM standard. Certifications shall not be more than 90 days old.
 4. Water: Submit name of source.
- B. Product Data: Prepare and submit product and performance data for materials and accessories, including patching compounds, waterstops, joint systems, curing compounds, finish materials and other concrete related items.
- C. Testing Agency Qualifications: When requested, the proposed testing agencies shall submit data on qualifications for acceptance.
- D. Concrete Mix Design:
1. Concrete mix design submittals shall be submitted at least 14 days prior to placing concrete.
 2. Submit concrete mixture proportions and characteristics for each concrete mix. Include standard deviation analysis or trial batch data with mix design. Submit historical field test data to demonstrate the average compressive strength for approval. Concrete mix proportions, materials, and handling methods for field test data or trial batches shall be the same as used for the work. Include the following information for each mix design:
 - a. Water/cementitious materials ratio.
 - b. Slump per ASTM C143
 - c. Air content per ASTM C231 or ASTM C173
 - d. Unit weight of concrete per ASTM C138
 - e. Compressive strength at 28 days per ASTM C39
 3. If trial batches are used, submit representative samples of each proposed ingredient to independent testing laboratory for use in preparation of mix design.
 4. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Indicate amounts of mix water to be withheld for later addition at Project site.
 5. Provide a record copy of the final mix designs and test results to the testing agency prior to commencement of the concrete work.
- E. LEED Certification: Submit manufacturer's certification for each concrete product including the following:
1. LEED Credit MRc 4.2 – Recycled content, including percentage by weight of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.
 2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

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- F. Concrete Finish Shop Drawings: Submit drawings indicating type of finish to be used at each location.
 - G. Slab-on-Grade Joint Layout: Submit drawings for proposed slab-on-grade control joint and construction joint layout for approval.
 - H. Test Reports: Submit laboratory test reports for concrete materials, mix design, compressive strength, slump, air content, and temperature. Each report shall indicate date of sampling, date of test, mix design, and location of concrete in structure.
 - I. Repair Methods: When stains, rust, efflorescence, and surface deposits must be removed, submit the proposed method of removal.
 - J. Certificates: Submit written certification regarding the design mix from the ready-mix supplier and the admixture manufacturer stating all concrete and admixtures do not contain chloride ions in excess of concentrations specified herein.
 - K. Placement Notification: Notify the Architect at least 24 hours in advance of concrete placement.
 - L. Adjustments: Submit any adjustments to mixture proportions or changes in materials, suppliers, or sources along with supporting documentation during the course of the work.
 - M. Cold Weather Procedure Submittal: Refer to Cold Weather Concreting article in Part 3 for more information.

1.5 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. Cementitious materials: Store cementitious materials in dry weather tight buildings, bins, or silos that exclude contaminants.
- B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates so as to drain freely.
- C. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Protect liquid admixtures from freezing and temperature changes, which would adversely affect their performance. Handle chemical admixtures in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland Cement: Portland cement shall conform to ASTM C150, Type I Normal, and be a standard brand of Portland cement. Use one brand of cement throughout project, unless approved in writing by the Engineer. Cement, which conforms to ASTM C150 Type II, may be used if it also meets the requirements of ASTM C150 Type I. Cement used in concrete shall be of the same brand and type as the cement used in the concrete represented by the submitted field test data or used in the trial mixtures. Maintain consistent cement color throughout project unless directed otherwise by architectural requirements.
 - 1. Total replacement of Portland cement by supplementary cementitious materials in design mixture shall not exceed 50% (by weight).
- B. Supplementary Cementitious Materials
 - 1. Fly Ash: Fly ash shall conform to ASTM C618, Class C or Class F. Replacement of Portland cement by fly ash shall not exceed the following (percentages are by weight):
 - a. Concrete Flatwork: 15 percent.
 - b. Mass Concrete (more than two feet thick): 50 percent.
 - c. All other concrete: 25 percent.

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- d. Concrete to be placed in cold weather as defined herein: No fly ash allowed unless the cold weather procedure submitted has compensated for the increased setting time and decreased rate of strength gain due to cold weather and fly ash.
- 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - a. Ground Granulated Blast-Furnace Slag Limit: 50% by weight of total cementitious materials.
 - b. In mass concrete more than 2 feet thick, the usage rate may be 80% by weight of total cementitious materials.
 - 3. Silica Fume: ASTM C1240, amorphous silica.
 - a. Silica Fume Limit: 10% by weight of total cementitious materials.
 - 4. Combined Fly Ash and Ground Granulated Blast-Furnace Slag:
 - a. Supplementary Cementitious Materials Limit: 50% with fly ash not exceeding 25% by weight of total cementitious materials.
 - b. In mass concrete more than 2 feet thick: 80% with fly ash not exceeding 50% by weight of total cementitious materials.
 - 5. Combined Fly Ash and Silica Fume:
 - a. Supplementary Cementitious Materials Limit: 35% with fly ash not exceeding 25% and silica fume not exceeding 10% by weight of total cementitious materials.
 - 6. Combined Fly Ash, Ground Granulated Blast-Furnace Slag, and Silica Fume:
 - a. Supplementary Cementitious Materials Limit: 50% with fly ash not exceeding 25% and silica fume not exceeding 10% by weight of total cementitious materials.
- C. Blended Hydraulic Cements
- 1. Portland Blast-Furnace Slag Cement: ASTM C 595, Type IS.
 - a. Blast-Furnace Slag Content: 25% to 50% by weight of total cementitious materials.
 - 2. Portland-Pozzolan Cement: ASTM C 595, Type IP.
 - a. Pozzolan Content: 15% to 40% by weight of Pozzolan total cementitious materials.
 - 3. Pozzolan-Modified Portland Cement: ASTM C 595, Type I (PM).
 - a. Pozzolan Content: 0% to 15% by weight of total cementitious materials.
 - 4. Slag-Modified Portland Cement: ASTM C 595, Type I (SM).
 - a. Blast-Furnace Slag Content: 0% to 25% by weight of total cementitious materials.

- D. Coarse Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide coarse aggregate from a single source for exposed concrete. Gradations shall be similar to that described in the following table:

COARSE AGGREGATE GRADATIONS							
SIEVE SIZE - PERCENT PASSING							
Grade No.	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 16
4	90-100 Note 1	20-55	0-15	---	0-5		---
57	100	95-100	---	25-60	0-10	0-10	---
67		100	90-100	---	20-55	0-10	---
89	---	---	---	100	90-100	20-55	0-10

1. Shall be 100 percent passing the 2" sieve.
2. A maximum of 30% of coarse aggregate may be recycled aggregate for footing and grade beam concrete.

- E. Fine Aggregate for Normal Weight Concrete: Comply with ASTM C33. Provide fine aggregate from a single source for exposed concrete. Fine aggregate shall consist of washed sand. Gradations shall be similar to that described in the following table:

FINE AGGREGATE GRADATIONS							
SIEVE SIZE - PERCENT PASSING							
Grade No.	3/8	No. 4	No. 8	No. 16	No. 50	No. 80	No. 100
FA	100	95-100	80-100	50-85	5-30	---	0-10

1. A maximum of 10% of fine aggregate may be recycled aggregate for footing and grade beam concrete.

- F. Do not use aggregates containing deleterious substances that could cause spalling on any exterior exposed surface. These include, but are not limited to the following:

1. Organic impurities.
2. Ferrous metals.
3. Soluble salts.
4. Coal, lignite, or other lightweight materials.
5. Soft particles.
6. Clay lumps and friable particles.
7. Cherts of less than 2.40 specific gravity.

- G. Water: Mixing water for concrete shall meet the requirements of ASTM C94. Water shall be clean and free from injurious amounts of acids, alkalies, organic materials, chloride ions and oils deleterious to concrete or reinforcing steel.

- H. Testing agency shall be given access to plants and stockpiles to obtain samples for testing for compliance with the Contract Documents.

2.2 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Calcium chloride thiocyanates or admixtures containing more than 0.05 percent chloride ions by weight are not permitted.
- B. Water Reducing Admixture: Material shall comply with ASTM C494, Type A. Acceptable manufacturers and products include:
1. Euclid Chemical Company - Eucon WR Series.
 2. Sika Chemical Corp. - Plastocrete 161.
 3. GRT – Polychem 400 NC.
 4. Grace Construction Products - WRDA 82.
- C. High Range Water Reducing Admixture (superplasticizer): Material shall comply with ASTM C494, Type F or Type G. Acceptable manufacturers and products include:
1. Euclid Chemical Company - Eucon 37 or Plastol Series.
 2. Sika – ViscoCrete 2100.
 3. GRT – Melchem.
 4. Grace Construction Products - Mira 110.
- D. High Range Water Reducing, Slump Retaining Admixture: Material shall comply with ASTM C494, Type F or Type G. Acceptable manufacturers and products include:
1. Euclid Chemical Company - Eucon 537, Eucon 1037, or Plastol Series.
 2. Sika – Sikament 686.
 3. GRT – Melchem – M.
 4. Grace Construction Products – ADVA FLEX.
- E. Non-Chloride Accelerator: Material shall comply with ASTM C494, Type C or Type E, and not contain a higher chloride ion concentration than municipal drinking water. Acceptable manufacturers and products include:
1. Euclid Chemical Company - Accelguard Series.
 2. Sika Chemical Corp. - Sika Rapid-1.
 3. GRT – Polychem HE.
 4. Grace Construction Products – Lubricon NCA.
- F. Air Entraining Admixture: Air entraining admixture shall comply with ASTM C260, and be certified by the manufacturer to be compatible with other admixtures to be used. Acceptable manufacturers and products include:
1. Euclid Chemical Company - Air-Mix or AEA Series.
 2. Sika Chemical Corporation - Sika-Aer.
 3. GRT – Polychem VR.
 4. Grace Construction Products - Darex II or Daravair 1000.
- G. Set Accelerating Corrosion-Inhibiting Admixture: Admixture shall contain at least 30% calcium nitrite, while meeting the requirements of ASTM C494 as a Type C admixture. Acceptable manufacturers and products include:
1. Euclid Chemical Company - Eucon CIA.
 2. Grace Construction Products - DCI.
- H. Admixtures used in concrete shall be the same brand, type, and dosage used in concrete represented by field test data or used in trial mixes.

2.3 CURING PRODUCTS

A. Moisture Retaining Cover

1. Plastic Film: Use 6 mil polyethylene film sheet materials that meet the requirements of ASTM C171.
2. White burlap-polyethylene sheet meeting ASTM C171.
3. Reinforced Curing Paper complying with ASTM C171.
4. Moisture Retaining Fabric: A naturally colored, non-woven, polypropylene fabric with a 4-mil, non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention. Acceptable manufacturers and products include:
 - a. PNA Construction Technologies, Inc.: Hydracure M15.
 - b. Reef Industries Incorporated: Transguard 4000.

B. Dissipating Resin Curing Compound: Clear, waterborne, membrane-forming curing compound complying with ASTM C309, Type 1, Class B shall be composed of hydrocarbon resins and dissipating agents that begin to break down upon exposure to ultraviolet light and traffic approximately 4 to 6 weeks after application, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions so as to not impair the later addition of applied finishes.

1. Curing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

C. Non-dissipating Curing Compound: Clear, membrane-forming curing compound complying with ASTM C309, Type 1, Class B.

1. Curing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

D. Curing and Sealing Compound: Clear, membrane-forming curing and sealing compound complying with ASTM C309, Type 1, and ASTM C1315, Type 1, Class A. Compound shall dry to a clear finish, resist yellowing due to ultraviolet degradation and provide a long lasting finish that has high resistance to chemicals, oil, grease, deicing salts, and abrasion.

1. Curing and sealing compounds used on interior enclosed environments shall be a water-borne product and VOC compliant as required by the U.S. EPA Architectural Coating Rule.

2.4 MISCELLANEOUS MATERIALS

A. Patching Mortar: Non-shrink, non-slump, non-metallic, quick setting. Acceptable manufacturers and products:

1. Euclid Chemical Company - Eucospeed.
2. BASF - Thorite.
3. Adhesive Technologies. - Hard Rok Vertipatch.
4. W.R. Meadows - Speed Crete (Red Line).
5. Dayton Superior – Re-Crete 20 minute.
6. SpecChem - Precast Patch.

B. Expansion Joint Material: Preformed, resilient, non-extruding asphalt impregnated resilient fiber conforming to ASTM D1751. Thickness of expansion joint material shall be 1/2" unless noted otherwise on the drawings.

- C. Magnesium phosphate patching cement specially designed for cold weather grouting and anchoring. Acceptable Manufacturer:
1. BASF - Set-45.
 2. Euclid Chemical Company - Eucospeed MP.
- D. Vapor Barrier: ASTM E 1745, Class A, not less than 15 mils (0.375 mm) thick. Acceptable manufacturers and products:
1. Stego Industries, LLC - Stego Wrap.
 2. W.R. Meadows, Inc. - Perminator.
 3. Raven Industries - Vapor Block.
 4. Insulation Solutions - Viper VaporCheck II.
- E. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete. Acceptable manufacturers and products:
1. Axim Concrete Technologies - Catexol 1000CL
 2. Cortec Corporation - MCI 2000 or MCI 2005
 3. W. R. Grace & Co - DCI or DCI-S
 4. Master Builders, Inc. - Rheocrete 222
 5. Sika Corporation - FerroGard-901
 6. Euclid Chemical Company - Eucon CIA
- F. Control Joint Filler: Flexible, single-component polyurethane sealant with backer rod compliant with ASTM C 920, Type S, Grade P, Class 25. Apply sealant per manufacturers written recommendations. Acceptable manufacturers and products:
1. Dayton Superior – Perma 230 SL.
 2. Euclid Chemical Company – Eucolastic I.
 3. Sonneborn – Sonolastic SL 1.

2.5 STRENGTH AND PROPERTIES

- A. Concrete Mix Designs: Refer to Drawings for specified compressive strength. Proportion concrete mixes according to the properties in the following tables. The concrete supplier may produce a mix at a lower water-cement ratio to allow for adjustment of slump at the site by adding water. The addition of site water shall be in accordance with ASTM C94, and the total water-cement ratio shall not exceed the value specified below.

Class	Coarse Aggregate Gradation	Fine Aggregate Gradation	Range of Slump	Max. w/c	Air Content	Other Requirements
A	57 or 67	FA	1" to 4"	0.40	5% to 8%	
B	57 or 67	FA	1" to 4"	0.45	5% to 8%	
C	57 or 67	FA	1" to 4"	0.50	—	
D	57 or 67	FA	4" to 6"	0.50	—	Use water reducing admixture to achieve slump specified
E	4 or 57	FA	1" to 4"	0.50	—	
F	4 or 57	FA	5" to 8"	0.50	—	Use retarder
H	89	FA	5" to 8"	0.50	—	

Class	Coarse Aggregate Gradation	Fine Aggregate Gradation	Range of Slump	Max. w/c	Air Content	Other Requirements
J	Lightweight	FA	5" max	0.5	4% to 7%	Maximum 107-116 pcf dry density

Note: w/c = water-cementitious materials ratio.

B. Schedule of Concrete Classes: Provide concrete of the specified class according to the following schedule.

1. Footings: Class E
2. Exterior foundation walls and piers: Class B
3. Interior piers: Class C
4. Retaining walls: Class B
5. Interior slabs on grade: Class D
6. Interior slab on metal decks: Class D
7. Interior beams and columns: Class C
8. Exterior beams and columns: Class B
9. Floor topping: Class H
10. Unless noted otherwise: Class B

C. Slump of Superplasticized Concrete: Concrete containing high-range water reducing admixtures (superplasticizer) shall have 8" maximum slump, unless otherwise approved by Structural Engineer. Concrete shall arrive at job site with 2" to 3" slump, be verified, then high range water reducing admixture added to increase slump to approved level.

D. Accelerators: Add non-chloride accelerator to all concrete slabs placed at air temperatures below 50°F.

E. Water Reducer: Add water reducing admixture or high range water reducing admixtures (superplasticizers) as follows:

1. All pumped concrete.
2. Fiber reinforced concrete.
3. As required for placement or workability.
4. As required by high temperatures, low humidity, or other adverse placement conditions.
5. Concrete with water-cementitious materials ratio below 0.50.

F. No other admixtures shall be used unless approved by Structural Engineer of record.

G. Chlorides: Admixtures or other ingredients including aggregates containing calcium chloride or more than 0.05% chloride ions by weight shall not be used.

H. Workability: Concrete shall have a workability such that it will fill the forms without voids, honeycombs, or rock pockets with proper vibration without permitting materials to separate or excess water to collect on the surface.

I. Concrete Temperatures: Minimum concrete temperature of fresh concrete varies in relation to average air temperature over a 24-hour period as follows:

- | | |
|---------------------------------|--------------------------------|
| 1. Air temperature below 0°F | Concrete temperature 70°F min. |
| 2. Air temperature 0°F to 30°F | Concrete temperature 65°F min. |
| 3. Air temperature 30°F to 50°F | Concrete temperature 50°F min. |
| 4. Air temperature above 50°F | No minimum temperature |

The maximum temperature of concrete at the time of delivery shall be 90°F. When concrete temperature exceeds 90°F, concrete supplier shall attempt to reduce temperature by shading aggregates and cement and cooling mix water. When these methods fail to reduce concrete temperature below 90°F, supplier shall use ice in the water to reduce the concrete temperature.

2.6 LEED CREDITS

- A. LEED Credit MRc 4.2 –Concrete flatwork shall contain at least 15% recycled cement (slag cement and fly ash). Concrete footings shall contain at least 50% recycled content. All other concrete shall contain at least 25% recycled cement.
- B. LEED Credit MRc 5.1/5.2 – Concrete shall be manufactured within 500 miles of the project site. Aggregate, sand and water shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Do not place concrete until data on materials and mix designs have been approved, Architect has been notified, and all other affected trades have coordinated their work.
- B. Remove snow, ice, frost, water, mud, and other foreign material from surfaces, reinforcing bars and embedded items against which concrete will be placed.
- C. Do not allow form release agent to contact reinforcing bars.
- D. Sandblast all existing concrete surfaces older than 28 days against which concrete is to be placed, unless directed otherwise in writing by Architect/Engineer.

3.2 SLABS

- A. Slab on Grade:
 - 1. All interior slabs on grades shall have a polyethylene vapor retarder conforming to ASTM E1745. Lap all joints minimum 6" and seal edges with adhesive tape. Fit vapor retarder around utilities and seal with adhesive tape as required. Place, protect, and repair vapor-retarder sheets according to ASTM E 1643 and manufacturer's written instructions.
 - 2. Refer to Drawings and Section 31 23 00 for required sub-grade preparation beneath slabs on grade.
 - 3. Where vapor retarder is not used below slab on grade, wet sub-grade below slab prior to placing concrete. Subgrade shall be moist with no free water and no muddy or soft spots.
 - 4. Saw cut control joints: Cut with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks. Control joints shall be located along column lines, with intermediate joints spaced at a maximum distance of 36 times the slab thickness, unless noted otherwise. Control Joints shall be continuous, not staggered or offset. Slab panels shall have a maximum length to width ratio of 1.5 to 1. Provide additional control joints at all reentrant or isolated corners formed in the slab on grade. Refer to Drawings for typical control joint detail.
 - 5. Provide isolation joints around each column and along foundation walls. Form isolation joints with 1/2" expansion joint material.
 - 6. Extend isolation joint material full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 7. Depress slabs as required for mats architectural finishes, pits and equipment. Obtain layout and locations from Architect.
 - 8. Verify completion of all under slab work with mechanical and electrical trades before placing slabs.

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9. Slope slabs as indicated on Drawings and to provide positive drainage. Slope slab keeping bottom level and varying top. Maintain minimum thickness of concrete as indicated on Drawings. Refer to floor finishes for tolerances.
- B. All slabs not on grade (all supported slabs), including slabs-on-steel decking and cast-in-place concrete slabs:
1. Supported slabs have deflections that may cause areas of concrete to have thicknesses greater than indicated on the Drawings. Contractor is expected to provide that volume as needed to finish the floor at the specified elevation. If specified floor finish tolerances are not achieved during the concrete floor construction, after formwork removal, the Contractor shall install, at no cost to the project, a self-leveling cementitious underlayment (Master Builders Mastertop 110 Underlayment or approved equal) to correct the floor flatness and levelness.
- C. Embedded Items:
1. The outside diameter of embedded conduit or pipe shall not exceed one-third of the slab thickness in structural slabs, including at crossovers, and shall be placed between the top and bottom reinforcing with a minimum 3" clear cover. Conduit or pipe running parallel to each other shall be spaced at least 8" apart and no more than 2 runs stacked vertically in the slab. Conduit or pipe shall not be embedded in any supported slab less than 6" thick. No embedded conduit or pipe is allowed in any concrete slab-on-steel deck.

3.3 CONSTRUCTION JOINTS

- A. Construction Sequence Submittal: Contractor shall submit a construction sequence indicating construction joints and the pour sequence.
- B. Beams: Locate construction joints for beams, joists, and girders in middle 1/3 of span, unless otherwise indicated on Drawings. When a beam intersects a girder at this point, the joint in the girder shall be offset a distance equal to or greater than twice the width of the beam. Make joints perpendicular to the main reinforcement.
- C. Vertical: Locate vertical construction joints in walls not farther than a maximum of 100 feet on center. Coordinate joint locations with architectural design.
- D. Horizontal: Locate horizontal joints in walls, piers and columns at underside of slabs, beams and at the top of slabs and footings unless otherwise indicated. At least 24 hours shall elapse between placing concrete in a wall, beam or column and placing concrete in an area supported by the walls, beams or columns, unless approved in writing by Structural Engineer.
- E. Reinforcing: Stop all welded wire reinforcement and/or reinforcing at construction joint in slabs on grade and provide dowel bars as detailed. Provide reinforcement at other construction joints as detailed. Roughen and thoroughly clean the surface of the concrete, remove all laitance, and wet the surface before placing new concrete against the joint. Slush vertical joints with a neat cement grout before placing new concrete.
- F. Wall Control Joints: Locate vertical control joints in exposed walls at a minimum uniform spacing not to exceed 25 feet-0 inches. Coordinate joint locations with Architectural Drawings.

3.4 CONCRETE PLACEMENT

- A. Place concrete as continuously as possible until placement is complete. Do not place against concrete that has attained initial set, except at authorized joints. If, for any reason, concrete pour is delayed for more than 45 minutes, bulkhead off pour at last acceptable construction joint. Immediately remove excess concrete and clean forms.
- B. Do not begin to place concrete during periods of rain, sleet or snow unless adequate protection is provided.
- C. No concrete shall be cast onto or against sub-grades containing free water, frost, ice or snow.

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- D. Notify the architect in advance if concrete is to be pumped.
 - E. Do not place concrete until all reinforcement is in place, forms have been thoroughly cleaned and approval has been given.
 - F. Do not accept concrete delivered to the job site more than 90 minutes after initial mixing.
 - G. Concrete from its point of release to mixers, hoppers, or conveyances, shall not be permitted to drop more than 5 feet (10 feet for concrete containing high range water reducers). Deposit concrete directly into conveyances and directly from conveyances to final points of deposit. Sufficient transportation equipment in good working order shall be on hand before work begins. All conveying equipment must be clean and kept clean during concreting operations. Take every possible precaution to prevent segregation or loss of ingredients.
 - H. Deposit concrete in wall forms in layers not greater than 12 inches in depth, each layer being compacted by internal vibration before succeeding layer is placed.
 - I. Place concrete as near as possible to its final position to prevent segregation. Do not use vibrators to transport concrete within forms. Consolidate concrete in walls, columns, beams and slabs or joist construction thicker than 8" with internal vibrators (8,000 to 12,000 V.P.M.). Slabs less than 8" thick may be consolidated with internal vibrators (9,000 to 13,500 V.P.M.) or vibrating screeds supported on forms, boards or rails, approved by Structural Engineer, supplement vibration by forking or spading by hand along surfaces adjacent to forms and construction joints.
 - J. Re-tempering of concrete will not be permitted. Concrete that has obtained its initial set shall be discarded.
 - K. Exercise care in placing concrete over waterproof membranes, rigid insulation and/or protection boards to avoid damaging those materials. Report damage immediately, and do not proceed until damage is repaired.
 - L. Remove loose debris from surfaces, thoroughly wet and slush with a neat cement grout immediately before placing new concrete, or apply bonding compound to surface and let dry before placing new concrete.
 - M. Protect existing concrete work to be exposed to view and other finished materials from damage and staining resulting from concreting operations. Handle concrete carefully to avoid dripping and spillage. Remove spilled concrete from existing surfaces immediately. Covering sills, ledges, and other surfaces with protective coverings may be necessary to protect the work.
 - N. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
 - O. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.5 CONCRETE FINISHES AND TOLERANCES

- A. Exposed Smooth Formed Surfaces: Remove forms and perform necessary repairs and patch to produce surface finish-3.0 as specified in ACI 301. Apply the following to smooth-formed finished concrete exposed to view in the finished work. Confirm finishes with architect prior to concrete placement by submitting shop drawings indicating locations of all types of finishes.
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

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- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 CONCRETE SLAB FINISHES AND TOLERANCES

A. Trowel Finish:

1. Screed concrete to an even plane, float, then power trowel the surface.
2. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled.
3. Provide trowel finish as indicated on the Drawings and at the following locations:
 - a. Concrete floors exposed in finished work unless otherwise indicated.
 - b. Slabs to receive curing compounds and sealers.
 - c. Slabs to receive resilient flooring or carpet.
 - d. Slabs to receive waterproof membranes.

B. Fine Broom Finish:

1. Screed concrete to an even plane, float, then power trowel the surface. Provide fine hair broom finish perpendicular to slope, free of loose particles, ridges, projections, voids and concrete droppings.
2. Provide fine broom finish as indicated on the Drawings and at the following locations:
 - a. Stoop slabs.
 - b. Raised curbs and walkway areas.
 - c. Slabs to receive thin set ceramic tile.

C. Broom Finish:

1. Screed concrete to an even plane and then float. Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a coarse broom across the surface.
2. Provide as indicated on the Drawings and at the following locations:
 - a. ADA ramp slabs.
 - b. Exterior walkway slabs.

D. Float Finish:

1. Screed concrete to an even plane then float.
2. Provide as indicated on the Drawings and at the following locations:
 - a. Slabs to directly receive concrete topping.
 - b. Roof slabs to receive loose laid roof insulation.

- E. Floor Finish Tolerances: Floor finish tolerances shall be measured by placing a freestanding (unleveled) 10 foot straightedge anywhere on the slab and allowing it to rest upon two high spots within 72 hours after placement of slab and removal of shoring (if present). The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed:

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1. Slab on Grade (Office, School): 1/4"
- F. Slab Drainage: Finish all concrete slabs to proper elevations to insure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear the cost of corrections to provide positive drainage.
 - G. Special Tolerances for Concrete Slabs: No abrupt change in vertical elevation of 1/4" or more is acceptable at the interface between slabs and within areas where pedestrian traffic is expected:

3.7 CONCRETE CURING

- A. Freshly placed concrete shall be protected from premature drying and excessively hot temperatures.
- B. Concrete other than high-early strength shall be maintained above 50°F and in a moist condition for at least the first 7 days after placement, except when special curing is used. Special curing procedures shall not be used without written permission from the Structural Engineer of Record.
- C. Formed surfaces shall be cured by leaving the formwork in place during the curing period.
- D. Protect concrete from excessive changes in temperature during the curing period and at the termination of the curing process. Changes in the temperature of the concrete shall be as uniform as possible and shall not exceed 5°F in any one hour or 50°F in any 24 hour period.
- E. Protect concrete from injury from the elements until full strength is developed. Protect from mechanical injury.
- F. During cold weather construction, all footings shall be protected from frost penetration until the building is enclosed and temporary heat is provided.

3.8 SLAB CURING

- A. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface. Use one of the methods described below.
- B. Moisture-Retaining-Cover Curing for Concrete Floors not Exposed in Final Condition: Cover concrete surface with waterproof sheet material as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be placed flat on the concrete surface, avoiding wrinkles. Sprinkle concrete with water as necessary during application of covering. Place in widest practicable width, with sides and ends lapped at least 12 inches, and seal with waterproof tape or adhesive. Verify that the concrete is continuously wet under the sheets; otherwise, add water through soaker hoses under the sheets. Weight down covering to prevent displacement. Immediately repair any holes or tears during the curing period using polyethylene sheet and waterproof tape. Curing process shall be maintained for a minimum of 7 days.
- C. Moisture-Retaining-Fabric Curing for Concrete Floors to Remain Exposed: Cover concrete surface with moisture retaining fabric as soon as finishing operations are complete and the concrete is sufficiently hard to be undamaged by covering. The cover shall be installed in accordance with manufacturer's written recommendations, in largest practical widths. Wet the slab to rejection, then thoroughly wet fabric side of cover and install with poly side up. Lap over adjacent covers a minimum of 18". Wet all laps and outside edges to prevent displacement and to ensure intimate contact with concrete and adjacent covers. Rewet as necessary and protect covers from damage during curing process.
 1. After minimum 7-day cure, remove moisture retaining fabric in sections.
 2. A maximum of 3,500 square feet of concrete curing cover may be removed at any one time. At no time shall the exposed area be permitted to dry prior to completion of the floor scrubbing process.

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3. Using a high powered floor scrubber capable of a minimum 80 pounds head pressure, and a mild citrus-based detergent that does not damage or mar the surface in any way, scrub the floor to remove any minerals or soluble salts that may have accumulated at the floor surface. Rinse area thoroughly with clean fresh water. Remove water and allow floor to dry. If whitening occurs during drying, repeat scrubbing process before floor dries until no whitening occurs during drying.
 4. All areas of the floor shall remain wet during floor scrubbing process. Expose only the amount of floor surface that can be cleaned before any drying occurs without exceeding the maximum allowable exposed area.
- D. Curing Compound: Apply uniformly in continuous operation by low pressure spray equipment or roller as soon as finishing operations are complete, free water on the surface has disappeared and no water sheen can be seen. Follow the manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period. Verify compatibility of the curing compound with paint, finishes, or toppings that require positive bond to the concrete. If curing compound is not compatible with paint finishes or toppings, utilize a dissipating curing compound and remove in accordance with the manufacturer's recommendations.

3.9 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
- B. Do not fill joints until construction traffic has permanently ceased.
- C. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- D. Install semi-rigid joint filler in saw-cut joints and in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.10 APPLICATION OF FLOOR SEALER - FINISH COAT

- A. Give concrete floors as indicated in Room Finish Schedule and where exposed in finished Work, second coat of curing and sealing compound immediately prior to Substantial Completion.
- B. Clean floors and apply sealer strictly according to manufacturer's instructions. Dilution and coverage shall be as recommended by the manufacturer. Apply sealer evenly.

3.11 COLD WEATHER CONCRETING

- A. Definition: Cold weather shall be defined as a period when for more than three successive days the average daily outdoor temperature drops below 40°F. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50°F occur during more than half of any 24 hour duration, the period shall not be regarded as cold weather.
- B. All cast-in-place concrete work occurring during cold weather shall conform to all requirements of ACI 306.1, "Standard Specification for Cold Weather Concreting", published by the American Concrete Institute, Detroit, Michigan, except as modified by the contract documents or this specification.
- C. Planning: The General Contractor, concrete contractor, concrete supplier and the architect shall have a pre-construction conference to outline the cold weather concreting operations concerning the placing, finishing, curing and protection of the concrete during cold weather. Pre-construction conference shall occur before cold weather is expected to occur.
- D. Detailed procedure submittal: Concrete contractor shall prepare and submit for review detailed procedures for the production, transportation placement, protection, curing and temperature monitoring of concrete during cold weather. Include procedures to be implemented upon abrupt changes in weather conditions. Do not begin cold weather concreting until these procedures have been reviewed and approved.

- E. **Mixing:** Concrete flatwork poured in cold weather shall be proportioned to obtain a lower slump to minimize the amount of bleed water during finishing. All bleed water should be skimmed off flatwork prior to troweling. Concrete that will be exposed to cycles of freezing and thawing while saturated should be properly air entrained as outlined in this specification.
- F. **Protection of Concrete:** Cure and protect concrete against damage from freezing for a minimum period of 72 hours, unless approved by the structural engineer. The protection period may be reduced according to ACI 306.1 requirements. Concrete contractor shall submit a letter of request to reduce the protection period, by outlining the method used to achieve the reduction per ACI 306.1.
1. When practical for the construction schedule, formwork shall be insulated and remain in place for at least the required protection period.
- G. **Concrete Temperatures:** The minimum temperature of concrete immediately after placement shall be as specified in the following table.

Section Size	Minimum temperature of concrete as placed and maintained during the protection period	Maximum gradual decrease in surface temperature during any 24 hours after the end of the protection.	Mixing Temperatures		
			Above 30°F	0 to 30°F	Below 0°F
< 12 in	55°F	50°F	60°F	65°F	70°F
12-36 in	50°F	40°F	55°F	60°F	65°F
36-72 in	50°F	30°F	50°F	55°F	60°F
> 72 in	50°F	20°F	45°F	50°F	55°F

- H. **Mixing Temperatures:** As the ambient air temperature decreases the concrete mixing temperature shall be increased to compensate for the heat lost in the period between mixing and placement. The concrete supplier shall use one or both of the following methods for increasing the concrete temperature.
1. Heating the mixing water to a temperature necessary to offset the temperature losses during transport. Supplier shall not heat water to temperatures in excess of 140°F, without taking special precautions as outlined in ACI 306.
 2. Heating the aggregate with a circulated steam piping system.
- I. **Temperature measurements:** The Contractor shall be responsible for monitoring and recording the concrete temperatures during placement and throughout the protection period.
1. Inspection personnel shall keep a record of the date, time, outside air temperature, temperature of concrete as placed, and weather conditions.
 2. Temperature of the concrete and the outside air shall be recorded at regular intervals but not less than twice in a 24 hour period. The record shall include temperatures at several points within the enclosure and on the concrete surface of sufficient frequency to determine a range of temperatures.
 3. Inspection agency shall submit the temperature logs to the Architect for permanent job records.

3.12 HOT WEATHER PROTECTION

- A. **Definition:** Hot weather shall be defined as any combination of high ambient temperature, low relative humidity, high winds and intense solar radiation that leads to higher than usual evaporation. The table below defines low relative humidity based on air temperature. For a given air temperature, if the relative humidity is equal to or less than the specified minimum, provisions for hot weather concreting shall be as follows:

Air Temperature	Minimum Relative Humidity
105°F	90%
100°F	80%
95°F	70%
90°F	60%
85°F	50%
80°F	40%
75°F	30%

- B. Scheduling: When hot weather is expected, adjust concrete placement schedules to avoid placing or finishing during the period from noon until 3:00 pm. When possible, slab pours should be delayed until the building is enclosed to protect the concrete from wind and direct sunlight, Construction schedule shall account for 7 day moist curing period.
- C. Mixing: Concrete supplier shall adjust mix designs and admixtures to minimize slump loss. Concrete shall be mixed at a water-cement, which is lower than the specified maximum to allow for the adjustment of slump by addition of water in the field. Water reduction shall be accomplished without reducing initial slump by increasing dosage of water reducing admixture.
- D. Preparation: Do not order concrete earlier than is required to avoid delays. Cool forms, subgrades and reinforcing bars with water spray from fog nozzle prior to concrete placement.
- E. Delivery: Site traffic shall be coordinated and delivery times scheduled to minimize waiting times for concrete trucks.
- F. Placement: Preparations shall be made to place and consolidate the concrete at the fastest possible rate. Maintain a continuous flow of concrete to the job site to avoid development of cold joints, during placement of slabs, apply fog spray to prevent moisture loss without causing surplus water to stand on concrete surface.
- G. Finishing: Finish concrete as fast as practical. Continue fogging concrete during finishing. Where fogging is not possible, apply sprayable moisture-retaining film between finishing passes.
- H. Curing: Formed concrete shall be covered with a waterproof material to retain moisture. Flat work shall be moisture cured as described in this specification. Moist curing shall continue for at least 7 days.

3.13 FIELD QUALITY ASSURANCE

- A. Independent Testing Agency and Inspector shall each perform their prescribed inspection, sampling, and testing services as described in Part 1 of this specification section.
- B. In cases where samples have not been taken or tests conducted as specified or strength of laboratory test cylinders for a particular portion of the structure fails to meet requirements of ACI 301, for evaluation of concrete strength, Structural Engineer shall have the right to order compressive or flexural test specimens or both be taken from the hardened concrete according to ASTM C42, load tests according to ACI 318, or such other tests as may be necessary to clearly establish the strength of the in situ concrete, and such tests shall be paid for by the Contractor.

3.14 REPAIR OF DEFECTIVE AREAS

- A. All repair of defective areas shall be made, with prior approval of Architect, as to method and procedure, in accordance with Section 5 of ACI 301, except specified bonding compound must be used.
- B. Patch form tie holes at the following locations:
 1. Unfinished exposed concrete (not scheduled for painting, plus at board formed concrete finish).
 2. All other areas: Prime voids with bonding compound and fill with patching mortar. Strike flush without overlap, float to uniform texture to match adjacent surfaces.

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3. Exposed areas scheduled for spray texture:
 - a. Remove projections and protrusions: 1/16" or larger.
 - b. Remove continuous ridges 1/32" or larger.
 - c. Fill voids and pin holes.
 4. Exposed areas scheduled for paint or epoxy:
 - a. Remove projections, ridges, and other protrusions 1/32" or larger.
 - b. Fill voids and pin holes 1/16" or larger.
 5. Exposed areas not scheduled for paint or other finishes:
 - a. Remove projections, ridges and other protrusions not conforming to requirements specified under Section 03 10 00.
 - b. Fill voids and pin holes not conforming to requirements specified under Section 03 10 00.
- C. All structural repairs shall be made, with prior approval of the Architect/Engineer, as to method and procedure, using the specified epoxy adhesive and/or epoxy mortar.
- D. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- E. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

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5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

3.15 CLEANING

- A. Clean exposed concrete to remove laitance, efflorescence and stains.

END OF SECTION 03 30 00

SECTION 03 41 00 - STRUCTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section includes engineering, fabrication and erection of structural precast concrete units. Work shall include, but not be limited to, the following items:
 - 1. Double Tee Deck Sections
- C. Work shall also include headers for openings, connections, anchor bolts, templates, installation instructions and grouting of precast units. Anchor bolts shall be installed by other contractor.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.
 - 1. ACI 301 - Standard Specifications for Structural Concrete.
 - 2. ACI 318 - Building Code Requirements for Reinforced Concrete.
 - 3. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 4. ASTM A82 - Standard Specification for Steel Wire, Plain for Concrete Reinforcement.
 - 5. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcing, Plain for Concrete Reinforcement.
 - 6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat-Treated 120/105 ksi Minimum Tensile Strength.
 - 7. ASTM A416 - Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
 - 8. ASTM A615 - Standard Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
 - 9. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 10. ASTM C150 - Standard Specification for Portland Cement.
 - 11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 12. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - 13. ASTM C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
 - 14. ASTM C1240 - Standard Specification for Silica Fume for use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout.
 - 15. AWS D1.1 - Structural Welding Code - Steel.

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16. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
 17. CRSI - Manual of Standard Practice.
 18. PCI MNL-120 - PCI Design Handbook – Precast and Prestressed Concrete.
 19. PCI MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
 20. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
 21. PCI MNL-123 - Manual on Design of Connections for Precast Prestressed Concrete.
 22. PCI MNL-124 - Manual on Design for Fire Resistance of Precast Prestressed Concrete.
 23. PCI MNL-126 - Manual for the Design of Hollow Core Slabs.
 24. PCI MNL-127 - Recommended Practice for Erection of Precast Concrete.
 25. PCI MNL-135 - Tolerance Manual for Pre-cast and Prestressed Concrete Construction.
 26. UL - Underwriter’s Laboratories.
- B. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
- C. Qualifications:
1. Fabricate and perform testing of precast units in accordance with PCI MNL-116 Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products and PCI MNL-117 Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.
 2. The engineer preparing design calculations, shop drawings, and other structural data for the precast concrete units shall be a registered Structural engineer in the state where the project is located, with not less than three (3) years of continuous experience in design work of similar scope to that shown on the drawings.
 3. The precast concrete manufacturer shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program prior to the start of production.
 4. The precast concrete manufacturer shall not have less than five (5) years of continuous experience in the manufacture of precast concrete units.
 5. The precast concrete manufacturer shall have production capacity to produce required units without causing delay in work.
 6. The precast concrete erector shall not have less than five (5) years of continuous experience in the erection of structural precast concrete units.
 7. All welding of structural steel shall be performed by operators who have been qualified within the past one year as prescribed in “Qualification Procedures” of the American Welding Society (AWS).

1.3 DESIGN REQUIREMENTS

- A. Precast units and their connections shall be designed by a licensed, qualified structural engineer licensed in the State where the project is located, to withstand the loadings and criteria indicated on the drawings and contained within this section.

- B. Precast units shall be designed to meet the project fire ratings as specified by the Architect.
- C. Precast double tee deck sections shall be designed as composite sections with the concrete topping slab indicated on the drawings.
- D. Fire-Test-Response Characteristics: Provide precast concrete units that comply with the following requirements:
 - 1. UL, ITS or another testing and inspecting agency acceptable to authorities having jurisdiction has performed fire-response testing on each assembly.
 - 2. Material and construction of fire-resistance-rated assemblies, as listed by UL's "Fire Resistance Directory," ITS's "Directory of Listed Products," or the listings of another testing and inspection agency, are identical to those tested per ASTM E119.
 - 3. Products are identified with appropriate markings of applicable testing and inspecting agency.

1.4 TESTING AND INSPECTION

- A. Inspection and Testing:
 - 1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
 - 2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
 - 3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.
 - 4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per approved testing and inspection program.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.
 - 5. Structural Component Testing and Inspection Schedule for Section 03 41 00 is as follows:

	Continuous	Periodic	Referenced Standard
Structural Precast Concrete			
Inspection of reinforcing steel, including prestressing tendons, and placement.		X	ACI 318: 3.5, 7.1-7.7
Inspection of reinforcing steel welding:			
A. Verification of weldability of reinforcing steel other than ASTM A706.		X	AWS D1.4, ACI 318: 3.5.2

	Continuous	Periodic	Referenced Standard
Structural Precast Concrete			
B. Shear reinforcement.	X		
C. Other reinforcing steel.		X	
Inspection of anchors installed in hardened concrete.		X	
Verifying use of required design mix.		X	ACI 318: 3.8.6, 8.1.3, 21.1.8
At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	X		ACI 318: Ch. 4, 5.2-5.4
Inspection of concrete placement for proper application techniques	X		ASTM C172, ASTM C31, ACI 318: 5.6, 5.8
Inspection for maintenance of specified curing temperature and techniques.		X	ACI 318: 5.9, 5.10
Inspection of prestressed concrete:			ACI 318: 5.11 - 5.13
A. Application of prestressing forces	X		
Erection of precast concrete members		X	ACI 318: 18.18.4
Verification of in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms		X	ACI 318: Ch. 16
Inspect formwork for shape, location and dimensions of the concrete member being formed.		X	ACI 318: 6.2

1.5 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit complete erection and detailed shop drawings for Engineer's approval, including but not limited to the following:
 - a. Member piece marks and completely dimensioned size, shape and type of each member.
 - b. Plans and/or elevations locating and defining all products furnished by the manufacturer. Indicate separate face and backup mix locations plus thicknesses and indicate the limits of each finish.
 - c. Indicate locations and extent and treatment of dry joints if two-stage casting is proposed.
 - d. Sections and details showing connections, cast-in items and their relation to the structure.
 - e. Methods of connecting, anchoring, fastening, bracing and attaching work of other trades.
 - f. Indicate welded connections by AWS standard symbols.

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- g. Indicate size and location of openings, either saw-cut or formed, to be coordinated with other trades.
 - h. Joints and openings in units and between units and the structure.
 - i. Description of all loose, cast-in and field hardware.
 - j. Headers required for openings.
 - 2. Manufacturer shall submit the shop drawings showing layout to the Mechanical Contractor for review of openings and inserts required by mechanical components.
 - B. Product Data:
 - 1. Products: Prepare and submit product data for Engineer's approval for shop applied primers, fasteners, grout and other miscellaneous materials.
 - 2. Concrete Design Mixes: Provide mix design for each type of concrete used.
 - C. LEED Submittals:
 - 1. LEED Certification: Submit manufacturer's certification for each concrete product including the following:
 - a. LEED Credit MRc 4.2 – Recycled content, including percentage by weight of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name and product cost.
 - b. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.
 - D. Qualification Data:
 - 1. When requested by the Architect, provide lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
 - E. Design Calculations:
 - 1. Prepare and submit one complete set of signed and sealed structural calculations to the Owner for approval of each unique and distinct precast member and precast connection prepared and certified by a Structural Engineer licensed in the state where the project is located. Owner's approval or acceptance of the manufacturer's design calculations shall in no way relieve the manufacturer of the full responsibility for the correctness of the calculations or the structural performance of the completed members or sections.
 - F. Production Drawings:
 - 1. Be prepared to submit, upon the Owner's request, production drawings indicating the following:
 - a. Elevation view of each member.
 - b. Sections and details to indicate quantities, type and position of reinforcing steel, anchors, inserts, etc.
 - c. Dimensions and finishes.
 - d. Prestress for strand and concrete strengths.

e. Methods for storage and transportation.

G. Test Reports:

1. Be prepared to submit, upon the Owner's request, test reports showing compliance with the testing provisions contained in PCI MNL-116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products and PCI MNL-117, Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.

H. Certifications:

1. Submit manufacturer's certifications that the precast units have been fabricated to meet the fire ratings specified by the Architect.
2. Submit copies of welding procedures and personnel.
3. Submit material certificates indicating that each manufacturer is in compliance with requirements for admixture, concrete materials, reinforcing materials, bearing pads, and water absorption tests.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Precast units shall be transported, stored and erected in a manner that will avoid any damage or deformation. Precast units shall be lifted and supported during manufacturing, stock-piling, transporting and erection operations only at the lifting and/or supporting points shown on the approved shop drawings.
- B. Store units at the project site in such a manner so as to prevent cracking, distortion, staining, or other physical damage, and so that markings are visible. Protect edges of precast units from chipping or spalling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Concrete Materials:

1. Refer to Section 03 30 00, Concrete, for additional information and requirements for concrete, formwork, materials application, admixtures, accessories, etc.
2. Portland Cement: ASTM C150, Type I or III, gray and white.
 - a. Standard gray Portland cement may be used for nonexposed backup concrete.
3. Normal-Weight Aggregates: ASTM C33
 - a. Face-Mix Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining.
 - b. Face-Mix Fine Aggregates: Selected, natural or manufactured sand of the same material as coarse aggregate, unless otherwise approved by Architect.
4. Admixtures – As determined by precast manufacturer, but conforming to:
 - a. Air-entraining Admixtures: ASTM C260.
 - b. Chemical Admixtures: ASTM C494.
 - c. Fly Ash: ASTM C618, Class C or F.
 - d. Silica Fume: ASTM C1240.
 - e. Plasticizing Admixture: ASTM C1017.

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5. Water – Potable and free from foreign materials in amounts harmful to concrete and embedded steel.
- B. Reinforcement and Prestressing Strands:
1. Refer to Section 03 20 00, Reinforcement, for additional information and requirements for fabrication, installation, etc.
 2. Reinforcing Bars - ASTM A615, Grade 60, deformed.
 3. Prestressing Strand - ASTM A416, Grade 250 or 270, uncoated, seven-wire, low-relaxation strand.
 4. Plain-Steel Wire - ASTM A82.
 5. Plain-Steel Welded Wire Reinforcement- ASTM A185, fabricated from steel wire into flat sheets.
- C. Anchors, Inserts and Connection Material:
1. Steel Plates and Shapes - ASTM A36.
 2. Anchor Rods - ASTM F1554.
 3. Deformed Bar Anchors - ASTM A496.
 4. Steel Headed Studs - AWS D1.1, Type B.
 5. High-Strength Bolts - ASTM A325.
 6. Welding Electrodes - Comply with AWS standards.
- D. Grout:
1. Cement Grout - Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C144. Mix at a ratio of 1.0 part cement to 2.5 parts sand, by volume, with minimum water required for placement and hydration. Minimum compressive strength to be 5000 psi.
 2. Non-metallic, non-shrink grout - Grout shall be a pre-mixed, non-metallic, non-corrosive, non-staining product, containing selected silica sand, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, and complying with ASTM C1107. Minimum compressive strength to be 7,000 psi at 28 days.
- E. Bearing Pads: Manufacturer to choose one of the following.
1. Elastomeric Pads: AASHTO M251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore A durometer, minimum tensile strength 2250 psi per ASTM D412.
 2. Random-Oriented, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Surface hardness of 70 to 90 Shore A durometer.
 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer. Surface hardness of 80 to 100 Shore A durometer.
 4. Hardboard: AHA A135.4, Class 1, tempered hardboard strips, smooth on both sides.
 5. High-Density Plastic: Multimer, nonleaching, plastic strip.
- F. Noncomposite Wythe Connectors:
1. Glass-fiber and vinyl-ester polymer connectors, polypropylene pin connectors, or stainless-steel pin connectors manufactured to connect wythes to connect wythes of precast concrete panels without shear transfer.

2.2 CONCRETE MIXES

- A. Concrete shall achieve a minimum 28-day compressive strength of 5000 psi.
- B. Prestressed concrete shall achieve a minimum release strength of 3500 psi.

2.3 FABRICATION AND MANUFACTURE

- A. Fabricate precast member in plastic lined or metal forms which are true to line and plane. Form openings of 100 square inches in area.
 - 1. Edge and Corner Treatment: Uniformly chamfered.
- B. General Contractor shall identify opening locations to precast manufacturer for coordination and shall provide precaster with cast-in items required by other trades.
- C. Manufacture units in compliance with PCI MNL-116. Comply with the tolerances specified in PCI MNL-116.
- D. Precast double tee deck sections shall have end bearings lengths as indicated on the structural drawings, but at least 8 inches minimum.
- E. Clean reinforcement of loose rust, mill scale, and other materials, which may reduce or destroy bond with concrete.
- F. Place reinforcement to obtain at least the minimum coverage for concrete protection as specified by ACI-318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- G. Install welded wire reinforcement in longest lengths practical. Lap adjoining pieces one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- H. Cast in structural inserts, plates and accessories as indicated on the Drawings and as determined by the fabricator for erection and anchorage. Cast in architectural accessories to receive windows, dowels, waterstops, flashings and other similar work.
- I. Provide cast-in-place or structural steel headers for openings larger than one slab width according to fabricator's written recommendations.
- J. Finishes, unless otherwise indicated on the drawings, provide:
 - 1. Precast double tees:
 - a. Standard underside - As resulting from casting against approved forms. Small surface holes, normal color variations, normal joint marks, minor chips and spalls will be tolerated. Major imperfections, honeycombs, structural defects, or other defects will not be tolerated.
 - b. Standard topside - As resulting from vibrating screed and additional hand finishing at projections. Normal color variations, normal joint marks, minor chips and spalls will be tolerated. Major imperfections, honeycombs, structural defects, or defects which would affect finished floor materials will not be tolerated.
 - c. Topside Finish for Composite Construction - Broom or rake top finish of precast concrete units for bonding with concrete floor topping.
 - d. Exposed ends - Strands shall be recessed a minimum of ½ in., the holes filled with grout and rubbed flush.

-
- K. Provide permanent markings to identify pick-up points and orientation in structure, complying with the markings indicated on approved shop drawings. Imprint date of casting on each precast unit on a surface, which will not show in the structure.

2.4 LEED CREDIT

- A. LEED Credit MRc 4.2 – Precast wall panels, hollowcore, double tees, columns, and beams shall have a maximum recycled content for standard products.
- B. LEED Credit MRc 5.1/5.2 – Precast shall be manufactured within 500 miles of project site. Aggregate, sand, water, and reinforcing shall be procured within 500 miles of project site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work is to be performed and notify the General Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Do not install precast concrete units until supporting concrete has attained 75% of its design compressive strength.

3.2 ERECTION

- A. The General Contractor shall be responsible for:
 - 1. Providing suitable access to the site, proper drainage, and firm, level bearing for the hauling and erection equipment to operate under their own power.
 - 2. At time of delivery, provide area inside and outside the building to allow adequate maneuverability for erection procedures.
 - 3. Placement and accurate alignment of anchor bolts, plates or dowels in footings or foundation walls, ledge angles and other field placed support units.
 - 4. Provide all shoring and bracing required by manufacturer's recommendations and as indicated on the Precast Shop Drawings.
- B. Install bearing pads on true, level and uniform bearing surfaces. Maintain the correct position of the pads until precast units are in place.
- C. Locate lifting hooks as specified on the shop drawings.
- D. Erect units in compliance with PCI MNL-127, Recommended Practices for Erection of Precast Concrete.
- E. After precast units are in place, remove lifting hooks and handling inserts, level bottom of slab to correct for unequal camber prior to grouting and perform necessary welding in accordance with AWS D1.1.
- F. Shore and brace precast units to maintain location, stability and alignment until permanent connections are established.
- G. Precast units shall be properly aligned and leveled as required by the shop drawings.
- H. Remove hoisting or shoring devices and fill voids with sand-cement grout to be flush to adjacent surfaces.

-
- I. Repair damaged metal surfaces by cleaning and applying a coat of galvanizing repair paint to galvanized surfaces or repainting damaged surfaces. Damage to those surfaces having special finishes as specified, shall be brought to the attention of the Architect.
 - J. Required openings less than 100 square inches in area in precast units shall be field cut. No openings shall be cut so as to pass through the leg sections of the prestressed units. Holes cut in slabs not concealed by finished ceiling systems shall be cut through, starting on underside with hand or mechanical chisels or from top only with core type drills. Restrict openings to as small as possible.
 - K. Welding: Comply with AWS D1.1 and AWS D1.4
 - 1. Protect precast concrete units and bearing pads from damage by field welding or cutting, and provide noncombustible shields as required.
 - L. Field touch up:
 - 1. Immediately after erection, field welding and/or final bolting, clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt and stains.

3.3 FIELD QUALITY CONTROL

- A. The contractor may choose to employ a separate testing laboratory to evaluate the precast manufacturer's quality control and testing methods. If requested, the precast manufacturer shall allow the Owner's testing company access to the manufacturing facility, and provide samples of material for additional evaluation.
- B. Precast units which do not conform to specified requirements, including strength, tolerances, and finishes, or which are damaged during handling and erection, shall be replaced with precast concrete units that meet the requirements of this specification.
- C. The contractor shall be responsible for the cost of corrections to other work affected by or resulting from corrections to precast concrete work.
- D. Precast units having dimensions greater than required will be rejected if appearance or function of the structure is adversely affected, or if larger dimensions interfere with other construction. The contractor shall be responsible for the cost of necessary repair, removal and replacement of rejected units.
- E. The precast supplier shall inspect all field cutting, which cuts reinforcing. The precast manufacturer shall issue a letter to the Owner either accepting the system as modified or directing corrective procedures to offset cut reinforcing. The contractor shall be responsible for the cost of any corrective procedures.
- F. Clean all exposed surfaces after erection to remove weld marks, other markings, stains and dirt. Wash and rinse according to manufacturer's recommendations. Protect other work from damage or staining during cleaning operations.

END OF SECTION 03 41 00

1 SECTION 042000 - UNIT MASONRY

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Concrete masonry units.
9 2. Clay face brick.
10 3. Mortar and grout.
11 4. Masonry-joint reinforcement.
12 5. Ties and anchors.
13 6. Embedded flashing.
14 7. Miscellaneous masonry accessories.

15 B. Products Installed but not Furnished under This Section:

- 16 1. Steel lintels in unit masonry.
17 2. Cavity wall insulation.

18 C. Related Requirements:

- 19 1. Section 033000 "Cast-in-Place Concrete" for **installing** dovetail slots for masonry anchors.
20 2. Section 044313.13 "Anchored Stone Masonry Veneer" for stone trim secured with stone anchors.

21 1.3 DEFINITIONS

- 22 A. CMU(s): Concrete masonry unit(s).

- 23 B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

24 1.4 PREINSTALLATION MEETINGS

- 25 A. Preinstallation Conference: Conduct conference at **Project site**.

26 1.5 ACTION SUBMITTALS

- 27 A. Product Data: For each type of product.

28 B. Sustainable Design Submittals:

- 29
30 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
31 regional materials indicating location and distance from Project of material manufacturer and point of

- 1 extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional
2 material and the fraction by weight that is considered regional.
- 3 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
4 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
5 product having recycled content.
- 6 C. Shop Drawings: For the following:
- 7 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
8 2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
9 3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with
10 ACI 315.
11 4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- 12 D. Samples for Initial Selection:
- 13 1. Weep holes/cavity vents.
- 14 E. Samples for Verification: For each type and color of the following:
- 15
16 1. **Clay face, in the form of straps of five or more bricks.**
17 2. **Pigmented and colored-aggregate** mortar. Make Samples using same sand and mortar ingredients to be
18 used on Project.
19 3. Accessories embedded in masonry.
- 20 1.6 INFORMATIONAL SUBMITTALS
- 21 A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers,
22 manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other
23 information as required to identify materials used. Include mix proportions for mortar and grout and source of
24 aggregates.
- 25 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the
26 Contract Documents unless such deviations are specifically brought to the attention of Architect and
27 approved in writing.
- 28 B. Qualification Data: For testing agency.
- 29 C. Material Certificates: For each type and size of the following:
- 30 1. Masonry units.
- 31 a. Include **data on material properties**.
32 b. For brick, include size-variation data verifying that actual range of sizes falls within specified
33 tolerances.
34 c. For exposed brick, include test report for efflorescence according to ASTM C 67.
35 d. For masonry units, include data and calculations establishing average net-area compressive strength
36 of units.
- 37 2. Integral water repellent used in CMUs.
38 3. Cementitious materials. Include name of manufacturer, brand name, and type.
39 4. Mortar admixtures.
40 5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
41 6. Grout mixes. Include description of type and proportions of ingredients.
42 7. Reinforcing bars.
43 8. Joint reinforcement.

- 1 9. Anchors, ties, and metal accessories.
- 2 D. Mix Designs: For each type of mortar **and grout**. Include description of type and proportions of ingredients.
- 3 1. Include test reports for mortar mixes required to comply with property specification. Test according to
4 ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for
5 air content.
- 6 2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive
7 strength requirement.
- 8 E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type,
9 provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area
10 compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.
- 11 F. Cold-Weather **and Hot-Weather** Procedures: Detailed description of methods, materials, and equipment to be used
12 to comply with requirements.

13 1.7 QUALITY ASSURANCE

- 14 A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate
15 aesthetic effects.
- 16 1. Build sample panels for **typical exterior wall** in sizes approximately **48 inches (1200 mm)** long by **36 inches**
17 **(900 mm)** high.
- 18 2. Build sample panels facing south.
- 19 3. Clean **one-half of** exposed faces of panels with masonry cleaner indicated.
- 20 4. Protect approved sample panels from the elements with weather-resistant membrane.
- 21 5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and
22 sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other
23 material and construction qualities specifically approved by Architect in writing.
- 24 a. Approval of sample panels does not constitute approval of deviations from the Contract Documents
25 contained in sample panels unless Architect specifically approves such deviations in writing.

26 1.8 DELIVERY, STORAGE, AND HANDLING

- 27 A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover
28 tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are
29 dry.
- 30 B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery
31 containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- 32 C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

33 1.9 FIELD CONDITIONS

- 34 A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at
35 end of each day's work. Cover partially completed masonry when construction is not in progress.
- 36 1. Extend cover a minimum of **24 inches (600 mm)** down both sides of walls, and hold cover securely in place.
- 37 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a
38 minimum of **24 inches (600 mm)** down face next to unconstructed wythe, and hold cover in place.

- 1 B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after
2 building masonry walls or columns.
- 3 C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted.
4 Immediately remove grout, mortar, and soil that come in contact with such masonry.
- 5 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground
6 and over wall surface.
- 7 2. Protect sills, ledges, and projections from mortar droppings.
- 8 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes,
9 from mortar droppings.
- 10 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and
11 dirt onto completed masonry.
- 12 D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not
13 build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply
14 with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- 15 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and
16 higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- 17 E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in
18 TMS 602/ACI 530.1/ASCE 6.

19 PART 2 - PRODUCTS

20 2.1 MANUFACTURERS

- 21 A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform
22 blend within the ranges accepted for these characteristics, from single source from single manufacturer for each
23 product required.
- 24 B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed
25 masonry, from single manufacturer for each cementitious component and from single source or producer for each
26 aggregate.

27 2.2 PERFORMANCE REQUIREMENTS

- 28 A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
- 29 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of
30 masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

31 2.3 UNIT MASONRY, GENERAL

- 32 A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract
33 Documents.
- 34 B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips,
35 cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed
36 Work.
- 37 C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1 1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing
2 agency acceptable to authorities having jurisdiction.

3 2.4 CONCRETE MASONRY UNITS

4 A. Regional Materials: Provide CMUs that have been manufactured within 500 miles of Project site from
5 aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500
6 miles of Project site.

7 B. Recycled Content of CMU Products: Preconsumer recycled content not less than 25 percent.

8 C. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units
9 unless otherwise indicated.

10 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other
11 special conditions.

12 2. Provide **square-edged** units for outside corners unless otherwise indicated.

13 D. CMUs: ASTM C 90.

14 1. Unit Compressive Strength: Units with minimum average net-area compressive strength of **1900 psi**.

15 2. Density Classification: **Normal weight**.

16 3. Size (Width): Manufactured to dimensions **3/8 inch (10 mm)** less than nominal dimensions.

17 2.5 CONCRETE AND MASONRY LINTELS

18 A. General: Provide one of the following:

19 B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing
20 bars indicated. **Provide lintels with net-area compressive strength not less than that of CMUs.**

21 C. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent
22 CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse
23 grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

24 2.6 BRICK

25 A. Regional Materials: Provide brick that has been manufactured within 500 miles of Project site from materials that
26 have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

27 B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces
28 of adjacent units:

29 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces,
30 provide units without cores or frogs and with exposed surfaces finished.

31 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions,
32 including those at corners, movement joints, bond beams, sashes, and lintels.

33 3. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces
34 being exposed to view.

35 C. Clay Face Brick: **Facing brick complying with ASTM C 216 or hollow brick complying with ASTM C 652, Class H40V**
36 **(void areas between 25 and 40 percent of gross cross-sectional area) are acceptable if brick meets all other**
37 **requirements of this specification.**
38

1. Brick BR-1
 - a. Acme Brick
 - b. Rustic White
2. Grade: **SW**
3. Type: **FBS**.
4. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of **4950 psi (34.13 MPa)**.
5. Initial Rate of Absorption: Less than **30 g/30 sq. in. (30 g/194 sq. cm)** per minute when tested according to ASTM C 67.
6. Initial Rate of Absorption: Greater than **5 g/30 sq. in. (30 g/194 sq. cm)** per minute when tested according to ASTM C 67.
7. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
8. Size (Actual Dimensions): **3-5/8 inches (92 mm) wide by 2-1/4 inches (57 mm) high by 7-5/8 inches (194 mm) long**.
9. Application: Use where brick is exposed unless otherwise indicated.

16 2.7 MORTAR AND GROUT MATERIALS

- A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles (800 km)** of Project site.
- B. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- E. Colored Cement Products: Packaged blend made from **portland cement and hydrated lime** and mortar pigments, all complying with specified requirements, and containing no other ingredients.
 1. Colored Portland Cement-Lime Mix:
 - a. Mortar Technologies
 - 1) Lite Golden Rod
 2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 3. Pigments shall not exceed 10 percent of portland cement by weight.
- F. Aggregate for Mortar: ASTM C 144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than **1/4 inch (6 mm)** thick, use aggregate graded with 100 percent passing the **No. 16 (1.18-mm)** sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- G. Aggregate for Grout: ASTM C 404.
- H. Water: Potable.

- 1 2.8 REINFORCEMENT
- 2 A. Recycled Content of steel reinforcing bars: Postconsumer recycled content plus one-half of preconsumer recycled
3 content not less than 90 percent.
- 4 B. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, **Grade 60 (Grade 420)**.
- 5 A. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to
6 hold reinforcing bars in center of cells. Units are formed from **0.148-inch (3.77-mm)** steel wire, hot-dip galvanized
7 after fabrication. Provide units designed for number of bars indicated equivalent to Hohmann & Barnard, Inc. #RB
8 or #RB-Twin Rebar Positioner. ASTM 153, Class B-2 coating.
- 9 B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
- 10 1. Interior Walls: **Hot-dip** galvanized carbon steel.
11 2. Exterior Walls: **Hot-dip galvanized carbon** steel.
12 3. Wire Size for Side Rods: **0.187-inch (4.76-mm)** diameter.
13 4. Wire Size for Cross Rods: **0.187-inch (4.76-mm)** diameter.
14 5. Spacing of Cross Rods and Cross Ties: Not more than **16 inches (407 mm)** o.c.
15 6. Provide in lengths of not less than **10 feet (3 m)**, **with prefabricated corner and tee units**.
- 16 C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder type with single pair of side rods.
- 17 1. Units shall be equivalent to Hohmann & Barnard, Inc. # 120.
- 18 2.9 TIES AND ANCHORS
- 19 A. General: Ties shall extend at least **1-1/2 inches (38 mm)** into veneer but with at least a **5/8-inch (16-mm)** cover on
20 outside face.
- 21 B. Materials: Provide ties specified in this article that are made from materials that comply with the following unless
22 otherwise indicated:
23
- 24 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
- 25 C. Individual Wire Ties: Rectangular or triangular units not less than **4 inches (100 mm)** wide.
26
- 27 1. Wire: Fabricate from **3/16-inch- (4.76-mm-)** wire.
- 28 D. Partition Top Anchors: **0.105-inch- (2.66-mm-)** thick metal plate with a **3/8-inch- (9.5-mm-)** diameter metal rod **6**
29 **inches (152 mm)** long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in
30 and out of tube. Fabricate from **steel, hot-dip galvanized after fabrication**.
- 31 E. Adjustable Masonry-Veneer Anchors:
- 32 1. Zinc-Coated, Steel Drill Screws for Steel Studs: Manufactured with hex washer head and neoprene or EPDM
33 washer, 3/8-inch diameter by length required to penetrate steel stud flange with not less than three
34 exposed threads, and with 92% Zamac 2 zinc coating with salt-spray resistance to red rust of more than 800
35 hours according to ASTM B 117.
36
- 37 a. Units shall be equivalent to Heckmann Building Products, No.75 Post-I-Tie barrel screw.
38 b. Provide concrete/CMU screw where needed for masonry backup.
39
- 40 2. Stainless-Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and
41 neoprene or EPDM washer, **No. 10 (4.83-mm)** diameter by length required to penetrate steel stud flange

1 with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-
2 steel drill point and 300 Series stainless-steel shank.

- 3
4 a. Units shall be equivalent to Hohmann & Barnard, Thermal 2-Seal anchor.
5 b. Provide concrete/CMU screw where needed for masonry backup.

6 F. Thermal Clip for Adjustable Wire Ties:

7 1. Composite Resin Material: Manufactured with high strength composite resin with low thermal conductivity.
8 UL-94 compliant.

9
10 a. Units shall be equivalent to Heckmann Building Products, Post-I-Tie thermal clip.

11 2. Steel reinforced plastic coated thermal break: Manufactured wing nut anchor with high strength flame
12 resistant plastic. UL-94 compliant.

13
14 a. Units shall be equivalent to Hohmann & Barnard, Thermal 2-Seal wing nut.

15 2.10 EMBEDDED FLASHING MATERIALS

16 A. Metal Flashing: Provide metal flashing complying with **SMACNA's "Architectural Sheet Metal Manual"** and as
17 follows:

- 18
19 1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, **0.016 inch (0.40 mm)** thick.
20 2. Fabricate continuous flashings in sections **96 inches (2400 mm)** long minimum, but not exceeding **12 feet**
21 **(3.7 m)**. Provide splice plates at joints of formed, smooth metal flashing.
22 3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive
23 counterflashing.
24 4. Fabricate through-wall flashing with drip edge **unless otherwise** indicated. Fabricate by extending flashing
25 **1/2 inch (13 mm)** out from wall, with outer edge bent down 30 degrees **and hemmed**.
26 5. Fabricate through-wall flashing with sealant stop **where** indicated. Fabricate by bending metal back on itself
27 **3/4 inch (19 mm)** at exterior face of wall and down into joint **1/4 inch (6 mm)** to form a stop for retaining
28 sealant backer rod.
29 6. Fabricate metal drip edges from stainless steel. Extend at least **3 inches (76 mm)** into wall and **1/2 inch (13**
30 **mm)** out from wall, with outer edge bent down 30 degrees **and hemmed**.
31 7. Fabricate metal sealant stops from stainless steel. Extend at least **3 inches (76 mm)** into wall and out to
32 exterior face of wall. At exterior face of wall, bend metal back on itself for **3/4 inch (19 mm)** and down into
33 joint **1/4 inch (6 mm)** to form a stop for retaining sealant backer rod.
34 8. Solder metal items at corners.

35 B. Flexible Flashing: Use the following unless otherwise indicated:

36 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-
37 asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall
38 thickness of not less than **0.040 inch**.

39 a. Products: Subject to compliance with requirements, available products that may be incorporated
40 into the Work include, but are not limited to, the following:

- 41 1) Advanced Building Products Inc.
42 2) Carlisle Coatings & Waterproofing.
43 3) Dayton Superior Corporation.
44 4) Grace Construction Products.
45 5) Heckmann Building Products Inc.
46 6) Hohmann & Barnard, Inc.
47 7) W. R. Meadows, Inc.
48 8) Sandell Manufacturing Co
49 9) Williams Products, Inc.

- 1
2 b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials
3 produced by flashing manufacturer.
- 4 C. Application: Unless otherwise indicated, use the following:
- 5 1. Where flashing is indicated to receive counterflashing, use metal flashing.
6 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
7 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing **with a**
8 **drip edge**.
9 4. Where flashing is fully concealed, use **flexible flashing**.
- 10 D. Solder and Sealants for Sheet Metal Flashings:
- 11 1. Solder for Stainless Steel: ASTM B 32, **Grade Sn60**, with acid flux of type recommended by stainless-steel
12 sheet manufacturer.
13 2. Elastomeric Sealant: ASTM C 920, chemically curing **silicone** sealant; of type, grade, class, and use
14 classifications required to seal joints in sheet metal flashing and remain watertight.
- 15 E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products
16 recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- 17 F. Termination Bars for Flexible Flashing: Aluminum bars **0.075 inch by 1 inch (1.90 mm by 25 mm)**.
- 18 G. Termination Bars for Flexible Flashing: Aluminum sheet **0.064 inch by 1-1/2 inches (1.63 mm by 38 mm)** with a **3/8-**
19 **inch (10-mm)** sealant flange at top.
- 20 2.11 MISCELLANEOUS MASONRY ACCESSORIES
- 21 A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35
22 percent; of width and thickness indicated; formulated from **neoprene**.
- 23 B. Preformed Control-Joint Gaskets: Made from **styrene-butadiene-rubber compound, complying with ASTM D 2000,**
24 **Designation M2AA-805** and designed to fit standard sash block and to maintain lateral stability in masonry wall;
25 size and configuration as indicated.
- 26 C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- 27 D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:
- 28 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint
29 and depth **1/8 inch (3 mm)** less than depth of outer wythe; in color selected from manufacturer's standard.
- 30 a. Products: Subject to compliance with requirements, provide one of the following:
31 1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
32 2) CavClear / Archovations, Inc.; CavClear Weep Vents
- 33 E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall
34 cavity.
- 35 1. Configuration: Provide one of the following:
- 36 a. Strips, full depth of cavity and **10 inches (250 mm)** high, with dovetail-shaped notches **7 inches (175**
37 **mm)** deep that prevent clogging with mortar droppings.
38 b. Strips, not less than full depth of cavity and **10 inches (250 mm)** high, with dimpled surface designed
39 to catch mortar droppings and prevent weep holes from clogging with mortar.
40

- 1 c. Sheets or strips, full depth of cavity and installed to full height of cavity.
- 2 d. Sheets or strips not less than full depth of cavity and installed to full height of cavity, with additional
- 3 strips **4 inches (100 mm)** high at weep holes and thick enough to fill entire depth of cavity and
- 4 prevent weep holes from clogging with mortar.

5 2.12 MORTAR AND GROUT MIXES

6 A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent

7 agents, antifreeze compounds, or other admixtures unless otherwise indicated.

- 8 1. Do not use calcium chloride in mortar or grout.
- 9 2. Use **portland cement-lime** mortar unless otherwise indicated.

10 B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by

11 weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

12 C. Mortar for Unit Masonry: Comply with ASTM C 270, **Property** Specification. Provide the following types of mortar

13 for applications stated unless another type is indicated.

- 14 1. For masonry below grade or in contact with earth, use Type M.
- 15 2. For reinforced masonry, use **Type S**.
- 16 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-
- 17 bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not
- 18 indicated, use Type N.
- 19 4. For interior nonload-bearing partitions, Type O may be used instead of Type N.

20 D. Pigmented Mortar: Use colored cement product.

- 21 1. Pigments shall not exceed 10 percent of portland cement by weight.
- 22 2. Mix to match Architect's sample.
- 23 3. Application: Use pigmented mortar for exposed mortar joints with the following units:

24 a. Clay face brick.

25 E. Grout for Unit Masonry: Comply with ASTM C 476.

- 26 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with
- 27 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
- 28 2. Proportion grout in accordance with ASTM C 476.
- 29 3. Provide grout with a slump of **8 to 11 inches** as measured according to ASTM C 143/C 143M.

30 PART 3 - EXECUTION

31 3.1 EXAMINATION

32 A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other

33 conditions affecting performance of the Work.

- 34 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance
- 35 of the Work.
- 36 2. Verify that foundations are within tolerances specified.
- 37 3. Verify that reinforcing dowels are properly placed.
- 38 4. Verify that substrates are free of substances that impair mortar bond.

1 B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping
2 connections.

3 C. Proceed with installation only after unsatisfactory conditions have been corrected.

4 3.2 INSTALLATION, GENERAL

5 A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-
6 wythe walls to actual widths of masonry units, using units of widths indicated.

7 B. Build chases and recesses to accommodate items specified in this and other Sections.

8 C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete
9 masonry to match construction immediately adjacent to opening.

10 D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining
11 construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before
12 laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges
13 concealed.

14 E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units
15 from several pallets or cubes as they are placed.

16 F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per
17 minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of
18 laying.

19 3.3 TOLERANCES

20 A. Dimensions and Locations of Elements:

- 21 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (12 mm) or minus 1/4
22 inch (6 mm).
- 23 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12
24 mm).
- 25 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch
26 (6 mm) in a story height or 1/2 inch (12 mm) total.

27 B. Lines and Levels:

- 28 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet (6
29 mm in 3 m), or 1/2-inch (12-mm) maximum.
- 30 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more
31 than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 32 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8
33 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 34 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control
35 joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in
36 6 m), or 1/2-inch (12-mm) maximum.
- 37 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in
38 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
- 39 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6
40 mm in 3 m), or 1/2-inch (12-mm) maximum.
- 41 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5
42 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

- 1 C. Joints:
- 2 1. For bed joints, do not vary from thickness indicated by more than plus or minus **1/8 inch (3 mm)**, with a
3 maximum thickness limited to **1/2 inch (12 mm)**.
- 4 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than **1/8 inch (3
5 mm)**.
- 6 3. For head and collar joints, do not vary from thickness indicated by more than plus **3/8 inch (9 mm)** or minus
7 **1/4 inch (6 mm)**.
- 8 4. For exposed head joints, do not vary from thickness indicated by more than plus or minus **1/8 inch (3 mm)**.
- 9 5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than **1/16
10 inch (1.5 mm)** from one masonry unit to the next.

11 3.4 LAYING MASONRY WALLS

- 12 A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for
13 accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units,
14 particularly at corners, jambs, and, where possible, at other locations.
- 15 B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in **running bond**, do not use
16 units with less-than-nominal **4-inch (100-mm)** horizontal face dimensions at corners or jambs.
- 17 C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than **4 inches (100
18 mm)**. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal **4-inch
19 (100-mm)** horizontal face dimensions at corners or jambs.
- 20 D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not
21 tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and
22 mortar, and wet brick if required before laying fresh masonry.
- 23 E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with
24 masonry around built-in items.
- 25 F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh,
26 or plastic mesh in the joint below, and rod mortar or grout into core.
- 27 G. Fill cores in hollow CMUs with grout **24 inches (600 mm)** under bearing plates, beams, lintels, posts, and similar
28 items unless otherwise indicated.
- 29 H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above
30 unless otherwise indicated.
- 31 1. Install compressible filler in joint between top of partition and underside of structure above.
- 32 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly
33 around plastic tubes of anchors and push tubes down into grout to provide **1/2-inch (13-mm)** clearance
34 between end of anchor rod and end of tube. Space anchors **48 inches (1200 mm)** o.c. unless otherwise
35 indicated.
- 36 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply
37 with Section 078443 "Joint Firestopping."

38 3.5 MORTAR BEDDING AND JOINTING

- 39 A. Lay as follows:
- 40 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
- 41 2. Bed webs in mortar in all courses of piers, columns, and pilasters.

- 1 3. Bed webs in mortar in grouted masonry, including starting course on footings.
2 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
3 5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in
4 mortar.
- 5 B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head
6 joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- 7 C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless
8 otherwise indicated.
- 9 D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless
10 otherwise indicated.
- 11 E. Cut joints flush where indicated to receive **waterproofing, cavity wall insulation, or air barriers** unless otherwise
12 indicated.
- 13 3.6 ANCHORED MASONRY VENEERS
- 14 A. Anchor masonry veneers to **wall framing and concrete and masonry backup** with masonry-veneer anchors to
15 comply with the following requirements:
- 16 1. Fasten **screw-attached** anchors **through sheathing to wall framing and to concrete and masonry backup**
17 with metal fasteners of type indicated.
18 2. Embed **tie sections** in masonry joints.
19 3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
20 4. Space anchors as indicated, but not more than **16 inches (406 mm)** o.c. vertically and **24 inches** o.c.
21 horizontally, with not less than one anchor for each **2.67 sq. ft. (0.25 sq. m)** of wall area. Install additional
22 anchors within **12 inches (305 mm)** of openings and at intervals, not exceeding **36 inches (914 mm)**, around
23 perimeter.
- 24 B. Provide not less than **2 inches (50 mm)** of airspace between back of masonry veneer and face of **insulation**.
- 25 1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from
26 airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins
27 protruding into airspace.
- 28 3.7 MASONRY-JOINT REINFORCEMENT
- 29 A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of **5/8 inch (16 mm)** on
30 exterior side of walls, **1/2 inch (13 mm)** elsewhere. Lap reinforcement a minimum of **6 inches (150 mm)**.
- 31 1. Space reinforcement not more than **16 inches (406 mm)** o.c.
32 2. Space reinforcement not more than **8 inches (203 mm)** o.c. in foundation walls and parapet walls.
33 3. Provide reinforcement not more than **8 inches (203 mm)** above and below wall openings and extending **12**
34 **inches (305 mm)** beyond openings.
- 35 B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- 36 C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- 37 D. Provide continuity at corners by using prefabricated L-shaped units.
- 38 E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing,
39 pipe enclosures, and other special conditions.

- 1 3.8 ANCHORING MASONRY TO CONCRETE
- 2 A. Anchor masonry to concrete where masonry abuts or faces concrete, to comply with the following:
- 3 1. Provide an open space not less than **2 inches (50 mm)** wide between masonry and structural steel or
4 concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
- 5 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
- 6 3. Space anchors as indicated, but not more than **24 inches (610 mm)** o.c. vertically and **36 inches (915 mm)**
7 o.c. horizontally.
- 8 3.9 CONTROL AND EXPANSION JOINTS
- 9 A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow
10 materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- 11 B. Form control joints in concrete masonry **using one of the following methods:**
- 12 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core
13 with grout, and rake out joints in exposed faces for application of sealant.
- 14 2. Install preformed control-joint gaskets designed to fit standard sash block.
- 15 C. Form expansion joints in brick as follows:
- 16
- 17 1. Build in compressible joint fillers where indicated.
- 18 2. Form open joint full depth of brick wythe and of width indicated, but not less than **1/2 inch (13 mm)** for
19 installation of sealant and backer rod specified in Section 079200 "Joint Sealants."
- 20 3.10 LINTELS
- 21 A. Install steel lintels where indicated.
- 22 B. Provide **concrete or masonry** lintels where shown and where openings of more than **12 inches (305 mm)** for brick-
23 size units and **24 inches (610 mm)** for block-size units are shown without structural steel or other supporting lintels.
- 24 C. Provide minimum bearing of **8 inches (200 mm)** at each jamb unless otherwise indicated.
- 25 3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS
- 26 A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to
27 downward flow of water in wall, and where indicated. **Install cavity vents at ledges and other obstructions to**
28 **upward flow of air in cavities, and where indicated.**
- 29 B. Install flashing as follows unless otherwise indicated:
- 30 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing.
31 Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with
32 mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape **as**
33 **recommended by flashing manufacturer.**
- 34 2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of
35 substrate at least **8 inches (200 mm)**; with upper edge **Fastened to substrate through termination bar.**
- 36 3. At lintels and shelf angles, extend flashing a minimum of **6 inches (150 mm)** into masonry at each end. At
37 heads and sills, extend flashing **6 inches (150 mm)** at ends and turn up not less than **2 inches (50 mm)** to
38 form end dams.

- 1 4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing **1 inch** back
2 from outside face of wall, and adhere flexible flashing to top of metal drip edge.
- 3 C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- 4 D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above
5 embedded flashing.
- 6 1. Use **specified weep/cavity vent products** to form weep holes.
7 2. Space weep holes **24 inches (600 mm)** o.c. unless otherwise indicated.
8 3. Place cavity drainage material in **airspace behind veneers** to comply with configuration requirements for
9 cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- 10 E. Install cavity vents in head joints in exterior wythes at spacing indicated. Use **specified weep/cavity vent products**
11 to form cavity vents.
- 12 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing
13 and weep holes above horizontal blocking.

14 3.12 REINFORCED UNIT MASONRY INSTALLATION

- 15 A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry
16 elements during construction.
- 17 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms
18 sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position
19 and shape during construction and curing of reinforced masonry.
20 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry
21 their own weight and that of other loads that may be placed on them during construction.
- 22 B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- 23 C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist
24 grout pressure.
- 25 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including
26 minimum grout space and maximum pour height.
27 2. Limit height of vertical grout pours to not more than **60 inches (1520 mm)**.

28 3.13 FIELD QUALITY CONTROL

- 29 A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports.
30 Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of
31 materials that fail to comply with specified requirements shall be done at Contractor's expense.
- 32 B. Testing Prior to Construction: One set of tests.
- 33 C. Testing Frequency: One set of tests for each **5000 sq. ft. (464 sq. m)** of wall area or portion thereof.
- 34 D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- 35 E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- 36 F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for **mortar air**
37 **content and compressive strength**.

1 G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

2 3.14 REPAIRING, POINTING, AND CLEANING

3 A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not
4 match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate
5 evidence of replacement.

6 B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar.
7 Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance.
8 Prepare joints for sealant application, where indicated.

9 C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears
10 before tooling joints.

11 D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

- 12 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
- 13 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
14 Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
- 15 3. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
- 16 4. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

17 3.15 MASONRY WASTE DISPOSAL

18 A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At
19 completion of unit masonry work, remove from Project site.

20 B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste
21 mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

- 22 1. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
- 23 2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill
24 material is specified in Section 312000 "Earth Moving."
- 25 3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

26 C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

27 D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or
28 recycled, and other masonry waste, and legally dispose of off Owner's property.

29 END OF SECTION 042000

1 SECTION 044313.13 - ANCHORED STONE MASONRY VENEER

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Stone masonry anchored to unit masonry backup.
9 2. Stone masonry anchored to cold-formed metal framing and sheathing.

- 10 B. Products Installed but Not Furnished under This Section Include:

- 11 1. Steel lintels in unit masonry.
12 2. Steel shelf angles for supporting unit masonry.

13 1.3 PREINSTALLATION MEETINGS

- 14 A. Preinstallation Conference: Conduct conference at Project site.

15 1.4 ACTION SUBMITTALS

- 16 A. Product Data: For each variety of stone, stone accessory, and manufactured product.

- 17 B. Sustainable Design Submittals:

- 18 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
19 regional materials indicating location and distance from Project of material manufacturer and point of
20 extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional
21 material and the fraction by weight that is considered regional

- 22 C. Samples for Verification:

- 23 1. For each stone type indicated. Include at least three Samples in each set and show the full range of color
24 and other visual characteristics in completed Work.
25 2. For each color of mortar required. Label Samples to indicate types and amounts of pigments used.

26 1.5 INFORMATIONAL SUBMITTALS

- 27 A. Qualification Data: For Installer.

- 28 B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers,
29 manufacturers' product names, supply sources, and other information as required to identify materials used.
30 Include mix proportions for mortar and source of aggregates.

1 1. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract
2 Documents contained in mockups unless Architect approves such deviations in writing.

3 C. Material Test Reports:

- 4 1. Stone Test Reports: For stone variety proposed for use on Project, by a qualified testing agency, indicating
5 compliance with required physical properties, other than abrasion resistance, according to referenced
6 ASTM standards. Base reports on testing done within previous five years.
7 2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not
8 stain or damage stone. Include interpretation of test results and recommendations for primers and
9 substrate preparation needed for adhesion.

10 1.6 QUALITY ASSURANCE

11 A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.

12 B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

- 13
14 1. Build mockups for each type of stone masonry in sizes approximately 48 inches (1200 mm) long by 48
15 inches high by full thickness, including face and backup wythes and accessories.
16 2. Protect accepted mockups from the elements with weather-resistant membrane.
17 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
18 mockups unless Architect specifically approves such deviations in writing.
19 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
20 undisturbed at time of Substantial Completion.

21 1.7 DELIVERY, STORAGE, AND HANDLING

22 A. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious
23 materials that have become damp.

24 B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

25 C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store
26 preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in
27 covered weatherproof dispensing silos.

28 D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

29 1.8 FIELD CONDITIONS

30 A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof
31 sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.

32 1. Extend cover a minimum of 24 inches (600 mm) down both sides and hold cover securely in place.

33 B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.

34 1. Protect base of walls from rain-splashed mud and mortar splatter using coverings spread on the ground and
35 over the wall surface.

36 2. Protect sills, ledges, and projections from mortar droppings.

37 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes,
38 from mortar droppings.

- 1 4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and
2 dirt on completed stone masonry.
- 3 C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not
4 build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply
5 with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- 6 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and
7 above and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- 8 D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in
9 TMS 602/ACI 530.1/ASCE 6.

10 1.9 COORDINATION

- 11 A. Advise installers of adjacent Work about specific requirements for placement of reinforcement, veneer anchors,
12 flashing, and similar items to be built into stone masonry.
- 13 B. Coordinate locations of dovetail slots installed in concrete that are to receive stone anchors.

14 PART 2 - PRODUCTS

15 2.1 MANUFACTURERS

- 16 A. Source Limitations for Stone: Obtain stone from single quarry with resources to provide materials of consistent
17 quality in appearance and physical properties.
- 18 B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious
19 component from single manufacturer and each aggregate from single source or producer.

20 2.2 LIMESTONE Stone

- 21 A. Material Standard: Comply with ASTM C 568/C 568M.
- 22 1. Classification: II Medium Density.
- 23 B. Regional Materials: Provide stone that have been quarried within 500 miles of Project site, as well as
24 manufactured, within 500 miles of Project site.
- 25 C. Description: Dolomitic limestone.
- 26 D. Varieties and Sources: Subject to compliance with requirements, available stone varieties that may be incorporated
27 into the Work include, but are not limited to, the following:
- 28 1. Kasota Cream Blend.
- 29 E. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

- 1 2.3 MORTAR MATERIALS
- 2 A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested,
3 or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- 4 B. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction;
5 natural color or white cement may be used as required to produce mortar color indicated.
- 6 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C 114.
- 7 C. Hydrated Lime: ASTM C 207, Type S.
- 8 D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- 9 E. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix
10 shall produce color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments shall
11 not exceed 10 percent of portland cement by weight.
- 12 1. [Mortar Technologies](#)
13 a. Lite Golden Rod
- 14 F. Aggregate: ASTM C 144 and as follows:
- 15 1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.
16 2. White Aggregates: Natural white sand or ground white stone.
17 3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color
18 necessary to produce required mortar color.
- 19 G. Water: Potable.
- 20 2.4 VENEER ANCHORS
- 21 A. Materials:
- 22 1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
23 2. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
- 24 B. Size: Sufficient to extend at least halfway, but not less than 1-1/2 inches (38 mm), through stone masonry and with
25 at least a 5/8-inch (16-mm) cover on exterior face.
- 26 C. Individual Wire Ties: Rectangular or triangular units not less than 4 inches (100 mm) wide.
27
- 28 1. Wire: Fabricate from 3/16-inch- (4.76-mm-) wire.
- 29 D. Adjustable Masonry-Veneer Anchors:
- 30 1. Zinc-Coated, Steel Drill Screws for Steel Studs: Manufactured with hex washer head and neoprene or EPDM
31 washer, 3/8-inch diameter by length required to penetrate steel stud flange with not less than three
32 exposed threads, and with 92% Zamac 2 zinc coating with salt-spray resistance to red rust of more than 800
33 hours according to ASTM B 117.
34
- 35 a. Units shall be equivalent to Heckmann Building Products, No.75 Post-I-Tie barrel screw.
36 b. Provide concrete/CMU screw where needed for masonry backup.
37
- 38 2. Stainless-Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and
39 neoprene or EPDM washer, No. 10 (4.83-mm) diameter by length required to penetrate steel stud flange

1 with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-
2 steel drill point and 300 Series stainless-steel shank.

- 3
4 a. Units shall be equivalent to Hohmann & Barnard, Thermal 2-Seal anchor.
5 b. Provide concrete/CMU screw where needed for masonry backup.

6 E. Thermal Clip for Adjustable Wire Ties:

7 1. Composite Resin Material: Manufactured with high strength composite resin with low thermal conductivity.
8 UL-94 compliant.

9
10 a. Units shall be equivalent to Heckmann Building Products, Post-I-Tie thermal clip.

11 2. Steel reinforced plastic coated thermal break: Manufactured wing nut anchor with high strength flame
12 resistant plastic. UL-94 compliant.

13
14 a. Units shall be equivalent to Hohmann & Barnard, Thermal 2-Seal wing nut.

15 2.5 STONE TRIM ANCHORS

16 A. Stone Trim Anchors: Units fabricated with tabs or dowels designed to engage kerfs or holes in stone trim units and
17 holes for fasteners or postinstalled anchor bolts for fastening to substrates or framing as indicated.

18 B. Materials: Fabricate anchors from stainless steel, ASTM A 240/A 240M or ASTM A 666, Type 304. Fabricate dowels
19 from stainless steel, ASTM A 276, Type 304.

20 C. Fasteners for Stone Trim Anchors: Annealed stainless-steel bolts, nuts, and washers; **ASTM F 593 (ASTM F 738M)** for
21 bolts and **ASTM F 594 (ASTM F 836M)** for nuts, **Alloy Group 1 (A1)**.

22 D. Postinstalled Anchor Bolts for Fastening Stone Trim Anchors: torque-controlled expansion anchors made from
23 stainless-steel components complying with **ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and**
24 **ASTM F 836M, Alloy Group A1 or A4)** for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or Type 316, for
25 anchors.

26 2.6 EMBEDDED FLASHING MATERIALS

27 A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual and as follows:

28 1. Stainless Steel: ASTM A 240/A 240M, Type 304, **0.016 inch (0.4 mm)** thick.

29 2. Fabricate continuous flashings in sections **96 inches (2400 mm)** long minimum, but not exceeding **12 feet**
30 **(3.6 m)**. Provide splice plates at joints of formed, smooth metal flashing.

31 3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive
32 counterflashing.

33 4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing
34 **1/2 inch (13 mm)** out from wall, with outer edge bent down 30 degrees and hemmed.

35 5. Fabricate through-wall flashing with sealant stop where indicated. Fabricate by bending metal back on itself
36 **3/4 inch (19 mm)** at exterior wall face and down into joint **3/8 inch (10 mm)** to form a stop for retaining
37 sealant backer rod.

38 6. Metal Drip Edges: Fabricate from stainless steel. Extend at least **3 inches (75 mm)** into wall and **1/2 inch (13**
39 **mm)** out from wall, with outer edge bent down 30 degrees and hemmed.

40 7. Metal Sealant Stops: Fabricate from stainless steel. Extend at least **3 inches (75 mm)** into wall and out to
41 exterior wall face. At exterior wall face, bend metal back on itself for **3/4 inch (19 mm)** and down into joint
42 **3/8 inch (10 mm)** to form a stop for retaining sealant backer rod.

43 8. Solder metal items at corners.

- 1 B. Flexible Flashing: For flashing unexposed to the exterior, use the following unless otherwise indicated:
- 2 1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive, rubberized-
- 3 asphalt compound, bonded to a high-density, cross-laminated, polyethylene film to produce an overall
- 4 thickness of not less than 0.040 inch (1.0 mm).
- 5 a. Products: Subject to compliance with requirements, available products that may be incorporated
- 6 into the Work include, but are not limited to, the following:
- 7 1) Advanced Building Products Inc.
- 8 2) Carlisle Coatings & Waterproofing.
- 9 3) Dayton Superior Corporation.
- 10 4) Grace Construction Products.
- 11 5) Heckmann Building Products Inc.
- 12 6) Hohmann & Barnard, Inc.
- 13 7) W. R. Meadows, Inc.
- 14 8) Sandell Manufacturing Co
- 15 9) Williams Products, Inc.
- 16
- 17 b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials
- 18 produced by flashing manufacturer.
- 19 C. Application: Unless otherwise indicated, use the following:
- 20 1. Where flashing is indicated to receive counterflashing, use metal flashing.
- 21 2. Where flashing is indicated to be turned down at or beyond wall face, use metal flashing.
- 22 3. Where flashing is partly exposed and is indicated to terminate at wall face, use metal flashing with a drip
- 23 edge.
- 24 4. Where flashing is fully concealed, use flexible flashing.
- 25 D. Solder and Sealants for Sheet Metal Flashings:
- 26 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel
- 27 sheet manufacturer.
- 28 2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use
- 29 classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- 30 2.7 MISCELLANEOUS MASONRY ACCESSORIES
- 31 A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35
- 32 percent; of width and thickness indicated; formulated from neoprene.
- 33 B. Cementitious Dampproofing for Limestone: Cementitious formulation recommended by ILI and nonstaining to
- 34 stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.
- 35 C. Weep/Vent Products: Use the following unless otherwise indicated:
- 36
- 37 1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint
- 38 and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.
- 39 a. Products: Subject to compliance with requirements, provide one of the following:
- 40 1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
- 41 2) CavClear / Archovations, Inc.; CavClear Weep Vents
- 42 D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall
- 43 cavity.

- 1 1. Provide one of the following configurations:
- 2 a. Strips, full depth of cavity and 10 inches (250 mm) wide, with dovetail-shaped notches 7 inches (175
- 3 mm) deep that prevent mesh from being clogged with mortar droppings.
- 4 b. Strips, not less than full depth of cavity and 10 inches (250 mm) wide, with dimpled surface
- 5 designed to catch mortar droppings and prevent weep holes from being clogged with mortar.
- 6 c. Sheets or strips, full depth of cavity and installed to full height of cavity.
- 7 d. Sheets or strips not less than full depth of cavity and installed to full height of cavity with additional
- 8 strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and
- 9 prevent weep holes from being clogged with mortar.

10 2.8 FABRICATION

- 11 A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
- 12 1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- 13 B. Split / Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings.
- 14 1. Cut and drill sinkages and holes in stone for anchors and supports.
- 15 C. Dress joints (bed and vertical) straight and at right angle to face unless otherwise indicated. Shape beds to fit
- 16 supports.
- 17 D. Carefully inspect stone at quarry or fabrication plant for compliance with requirements for appearance, material,
- 18 and fabrication. Replace defective units before shipment.
- 19 1. Clean sawed backs of stone to remove rust stains and iron particles.
- 20 E. Thickness of Stone: Provide thickness indicated, but not less than the following:
- 21 1. Thickness: 3 1/2 inches plus or minus 1/4 inch.
- 22 F. Face size: Provide face size indicated, but not less than the following:
- 23 1. Face: 3 5/8 inches plus or minus 1/16 inch.
- 24 G. Pattern:
- 25 1. Sawed-bed, range ashlar with uniform course heights (4-inch) with random lengths (12-inch – 36inch +/-).
- 26 H. Finish exposed stone faces and edges to comply with requirements indicated for finish and to match approved
- 27 samples and mockups.
- 28 1. Finish: Split face.
- 29 2. Finish for Sills: Smooth at brick veneer and Split face with sand-rubbed washes at stone veneer.
- 30 3. Finish for Copings: Split face, front and back; sand-rubbed top.
- 31 a. Finish exposed ends of copings same as front and back faces.

32 2.9 MORTAR MIXES

- 33 A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent
- 34 agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

- 1 1. Do not use calcium chloride.
- 2 2. Use portland cement-lime mortar unless otherwise indicated.
- 3 3. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding
- 4 water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its
- 5 form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add
- 6 remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes
- 7 of final mixing; do not retemper or use partially hardened material.

- 8 B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by
- 9 weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- 10 C. Mortar for Stone Masonry: Comply with ASTM C 270, Property Specification.

- 11 1. Mortar for Setting Stone: Type S.
- 12 2. Mortar for Pointing Stone: Type N.

- 13 D. Pigmented Mortar: Use colored cement product.

- 14 1. Pigments shall not exceed 10 percent of portland cement by weight.
- 15 2. Mix to match Architect's sample.

16 PART 3 - EXECUTION

17 3.1 EXAMINATION

- 18 A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for
- 19 installation tolerances and other conditions affecting performance of stone masonry.

- 20 B. Examine substrate to verify that reinforcement, veneer anchors, flashing, and other items installed in substrates
- 21 and required for or extending into stone masonry are correctly installed.

- 22 C. Examine wall framing, sheathing, and weather-resistant sheathing paper to verify that stud locations are suitable
- 23 for spacing of veneer anchors and that installation will result in a weatherproof covering.

- 24 D. Proceed with installation only after unsatisfactory conditions have been corrected.

25 3.2 PREPARATION

- 26 A. Accurately mark stud centerlines on face of weather-resistant sheathing paper before beginning stone installation.

- 27 B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by
- 28 thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds
- 29 that contain no caustic or harsh materials or abrasives.

30 3.3 SETTING STONE MASONRY

- 31 A. Perform necessary field cutting and trimming as stone is set.

- 32 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges
- 33 eased slightly to prevent snipping.
- 34 2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true,
- 35 matching similar surfaces that were shop or quarry fabricated.

- 1 B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic
2 effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- 3 C. Arrange stones in range ashlar pattern with course heights as indicated, random lengths, and uniform joint widths,
4 with offset between vertical joints as indicated.
- 5 D. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place.
- 6 E. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and
7 indicated tolerances.
- 8 F. Install steel lintels where indicated. Provide minimum bearing of **8 inches (200 mm)** at each jamb unless otherwise
9 indicated.
- 10 G. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are
11 required to maintain bond alignment if any. Lay walls with joints not less than **1/4 inch (6 mm)** at narrowest points
12 or more than **3/8 inch (10 mm)** at widest points.
- 13 H. Provide sealant joints of widths and at locations indicated.
- 14 1. Keep sealant joints free of mortar and other rigid materials.
15 2. Sealant joints are specified in Section 079200 "Joint Sealants."
- 16 I. Install embedded flashing and weep holes at shelf angles, lintels, ledges, other obstructions to downward flow of
17 water in wall, and where indicated.
- 18 1. At masonry-veneer walls, extend flashing through stone, across airspace behind veneer, and up face of
19 substrate at least **8 inches (200 mm)**; with upper edge Fastened to substrate through termination bar.
20 2. At lintels and shelf angles, extend flashing full length of angles but not less than **6 inches (150 mm)** into
21 masonry at each end.
22 3. At sills, extend flashing not less than **4 inches (100 mm)** at ends.
23 4. At ends of head and sill flashing, turn up not less than **2 inches (50 mm)** to form end dams.
24 5. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing **1 inch** back from
25 exterior wall face and adhere flexible flashing to top of metal drip edge.
- 26 J. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- 27 K. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf
28 angles, and at flashing.
- 29 1. Use specified weep/cavity vent products to form weep holes.
30 2. Space weep holes **24 inches (600 mm)** o.c.
31 3. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage
32 material in "Miscellaneous Masonry Accessories" Article.
- 33 L. Install vents in head joints at top of each continuous cavity at spacing indicated. Use specified weep/cavity vent
34 products to form vents.
- 35 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing
36 and weep holes above horizontal blocking.
- 37 M. Coat limestone with cementitious dampproofing as follows:
- 38 1. Stone at Grade: Beds, joints, and back surfaces to at least **12 inches (300 mm)** above finish-grade elevations.
39 2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
40 3. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage
41 or remove dampproofing in the course of handling and setting stone.

- 1 3.4 CONSTRUCTION TOLERANCES
- 2 A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20
3 feet (10 mm in 6 m), or 1/2 inch in 40 feet (13 mm in 12 m) or more. For external corners, expansion joints, control
4 joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in
5 12 m) or more.
- 6 B. Variation from Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other
7 conspicuous lines, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (13 mm in 12 m) or more.
- 8 C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet (13 mm in 6 m) or 3/4
9 inch in 40 feet (19 mm in 12 m) or more.
- 10 D. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone
11 face from level, plumb, or dimensioned plane.
- 12 E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
- 13 F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.
- 14 3.5 INSTALLATION OF ANCHORED STONE MASONRY
- 15 A. Anchor stone masonry to wall framing and concrete and masonry backup screw-attached veneer anchors unless
16 otherwise indicated.
- 17 B. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than 1-1/2 inches (38 mm),
18 through stone masonry and with at least a 5/8-inch (16-mm) cover on exterior face.
- 19 C. Space anchors not more than 16 inches (400 mm) o.c. vertically and 24 inches (600 mm) o.c. horizontally. Install
20 additional anchors within 12 inches (300 mm) of openings, sealant joints, and perimeter at intervals not exceeding
21 12 inches (300 mm).
- 22 D. Anchor stone trim with stone trim anchors where indicated. Install anchors by fastening to substrate and inserting
23 tabs and dowels into kerfs and holes in stone units. Provide compressible filler in ends of dowel holes and bottoms
24 of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with
25 mortar.
- 26 E. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as
27 stone is set.
- 28 F. Provide 2-inch (50-mm) cavity between stone masonry and backup construction unless otherwise indicated. Keep
29 cavity free of mortar droppings and debris.
- 30 1. Slope beds toward cavity to minimize mortar protrusions into cavity.
31 2. Do not attempt to trowel or remove mortar fins protruding into cavity.
- 32 G. Rake out joints for pointing with mortar to depth of not less than 1/2 inch (13 mm) before setting mortar has
33 hardened. Rake joints to uniform depths with square bottoms and clean sides.
- 34 3.6 POINTING
- 35 A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar
36 was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch (10
37 mm) deep until a uniform depth is formed.

1 B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch (10 mm) deep.
2 Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.

3 C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint
4 profile:

5 1. Joint Profile: Concave.

6 3.7 ADJUSTING AND CLEANING

7 A. Remove and replace stone masonry of the following description:

8 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are
9 approved by Architect.

10 2. Defective joints.

11 3. Stone masonry not matching approved samples and mockups.

12 4. Stone masonry not complying with other requirements indicated.

13 B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other
14 requirements, and showing no evidence of replacement.

15 C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling
16 joints.

17 D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:

18 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

19 2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain City
20 construction Manager's approval of sample cleaning before cleaning stone masonry.

21 3. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20,
22 Revised II, using job-mixed detergent solution.

23 4. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

24 3.8 EXCESS MATERIALS AND WASTE

25 A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.

26 B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by
27 crushing and mixing with fill material as fill is placed.

28 1. Crush masonry waste to less than 4 inches (100 mm) in greatest dimension.

29 2. Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste. Fill
30 material is specified in Section 312000 "Earth Moving."

31 3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

32 C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and
33 other waste, and legally dispose of off Owner's property.

34 END OF SECTION 044313.13

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SECTION 05 12 23 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section includes fabrication and erection of structural steel work, as shown on the Drawings and specified herein. Work shall include, but not be limited to the following items:
 - 1. Structural steel
 - 2. Base and bearing plates.
 - 3. Deck support angles and framing for roof openings.
 - 4. Steel lintel members for masonry openings.
 - 5. Edge angles and bent plates.
 - 6. Connection plates.
 - 7. Shear stud connectors.
 - 8. All other steel items as listed in AISC – “Code of Standard Practice for Steel Buildings and Bridges” as shown on structural and architectural drawings.
- C. Work shall also include grouting of all structural steel members where indicated.
- D. Structural notes indicated on the drawings regarding structural steel framing should be considered a part of this specification.
- E. Information provided on paper-based contract documents will govern over information provided in electronic model transfer.
- F. No substitutions will be allowed without the Engineer’s approval.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards except where more stringent requirements are shown or specified.
 - 1. AISC - Specification for Structural Steel Buildings – Allowable Stress Design and Plastic Design, 9th Edition.
 - 2. AISC - Specification for Structural Joints Using ASTM A325 or A490 Bolts.
 - 3. AISC - Code of Standard Practice for Buildings and Bridges.
 - 4. AISC - Specification for the Design of Steel Hollow Structural Sections.
 - 5. AISC - Specification for Allowable Stress Design of Single-Angle Members or Specification for Load and Resistance Factor Design of Single-Angle Members.
 - 6. AISC 360-05 – Specification for Structural Steel Buildings – Allowable Strength Design, 13th Edition.
 - 7. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 8. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 - 9. ASTM A108 - Standard Specification for Steel Bar, Carbon, Cold-Finished, Standard Quality.

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10. ASTM A123 - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
 11. ASTM A153 - Standard Specification for Zinc Coating (Hot Dip), on Iron and Steel Hardware.
 12. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
 13. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 14. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 15. ASTM A490 - Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.
 16. ASTM A500 - Standard Specification for Cold Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 17. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 18. ASTM A572 - Standard Specification for High Strength, Low-Alloy Columbium-Vanadium Structural Steel.
 19. ASTM A992 - Standard Specification for Steel for Structural Shapes for use in Building Framing.
 20. ASTM A1085 - Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections.
 21. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 22. ASTM F436 - Standard Specification for Hardened Steel Washers.
 23. ASTM F1554 - Standard Specification for Anchor Bolts, Steel 36, 55 and 105 ksi Yield Strength
 24. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 25. ASTM F2280 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 150 ksi Minimum Tensile Strength
 26. AWS D1.1 - Structural Welding Code.
 27. SSPC - Steel Structures Painting Council.
- B. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
- C. Fabrication, Erection, and Welding Qualifications:
1. Fabricate structural steel members in accordance with AISC Specification for the design, fabrication and erection of structural steel for buildings.
 2. Steel fabricator shall not have less than five (5) years of continuous experience in fabrication of structural steel framing.
 3. Steel detailer shall have five (5) years of continuous experience in the production of steel fabrication drawings.

4. Steel erector shall not have less than five (5) years of continuous experience in the erection of structural steel framing.
 5. All welding of structural steel shall be performed by operators who have been recently qualified as prescribed in "Qualification Procedures" of the American Welding Society (AWS).
- D. Tolerances: Tolerances shall be as indicated by the AISC Code of Standard Practice for Buildings and Bridges except that tolerances for fabricating, rolling, cambering and erection shall not be cumulative.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.
4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per approved testing and inspection program.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.
5. Structural Component Testing and Inspection Schedule for Section 05 12 23 is as follows:

Structural Steel	Continuous	Periodic	Referenced Standard
1. Material verification of high-strength bolts, nuts, and washers:			
A. Identification markings to conform to ASTM standards specified in the approved construction documents.		X	Applicable ASTM material standards: AISC 360, Section A3.3
B. Manufacturer's certificate of compliance required.		X	
2. Inspection of high-strength bolting:			
A. Snug-tight joints.		X	AISC 360, Section M2.5
B. Pretensioned and slip-critical joints using turn-of-nut with matchmarking or direct tension indicator methods of installation.		X	
C. Pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation.	X		
3. Material verification of structural steel:			
A. Identification markings to conform to AISC 360.		X	AISC 360, Section M5.5

Structural Steel	Continuous	Periodic	Referenced Standard
B. Manufacturer's certified test reports.		X	
4. Material verification of weld filler materials:			
A. Identification markings to conform to AWS specification in the approved construction documents.		X	AISC 360, Section A3.5 and applicable AWS A5 documents
B. Manufacturer's certificate of compliance required		X	
5. Inspection of welding:			
A. Complete and partial joint penetration groove welds	X		AWS D1.1
B. Multi-pass fillet welds	X		AWS D1.1
C. Single-pass fillet welds > 5/16" (7.9 mm)	X		AWS D1.1
D. Plug and slot welds.	X		AWS D1.1
E. Single-pass fillet welds ≤ 5/16" (7.9 mm)		X	AWS D1.1
F. Composite stud testing		X	AWS D1.1
6. Inspection of steel frame joint details for compliance:			
A. Details such as bracing and stiffening.		X	
B. Member locations.		X	
C. Application of joint details at each connection.		X	

1.4 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit complete erection and detailed shop drawings for Engineer's approval, including framing plans indicating size, weight and location of all structural members. Shop drawings shall indicate methods of connecting, anchoring, fastening, bracing and attaching work of other trades.
 - a. Where contract documents indicate verify in field (VIF) dimensions, shop drawings shall indicate these dimensions and Contractor shall note that the dimensions have been verified.
 - b. This specification modifies the AISC Code of Standard Practice by deleting the following sentence from paragraph 4.2.1: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as part of his preparation of these shop drawings." Review of the shop drawings by the Engineer shall not relieve the fabricator of this responsibility.
 - c. This specification modifies AISC Code of Standard Practice by deleting the following sentence from 4.4.1(c): "Release by the Owner's Designated Representatives for Design and Construction for the Fabricator to begin fabrication using the approved submittals." Review of the shop drawings by the Engineer shall not relieve the fabricator of this responsibility.
2. Furnish both the Engineer and Architect with one copy of the following:
 - a. Final shop drawings containing all review notations.
 - b. Field Use/For Construction Drawings.
3. The steel fabricator shall submit a setting plan for all embedded items for Engineer's approval.
4. Welder's Certification: Submit certification for all welders employed on the project demonstrating they have been AWS qualified to perform the welding procedures required for this project.

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5. General Contractor/Construction Manager to provide copies of field concrete cylinder breaks indicating the concrete meets 75% of the design compressive strength to the steel erector.
- B. The General Contractor shall conduct a field survey of as-built anchors and bearing plate locations and elevations prior to steel erection. Survey shall be furnished to the steel fabricator. Contractor shall identify deviations from approved shop drawings and submit proposed repairs and modifications to the Engineer and steel fabricator for approval.
 - C. Product Data:
 1. Prepare and submit product data for Engineer's approval for shop applied primers, finished paint system, expansion and/or adhesive anchors, non-shrink grout and other miscellaneous materials.
 - D. LEED Certification: Submit manufacturer's certification for each steel product including the following:
 1. LEED Credit MRc 4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.
 2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.
- 1.5 PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Steel members shall be transported, stored and erected in a manner that will avoid any damage or deformation. Materials should be stored to allow easy access for inspection and identification. Bent or deformed members will be rejected and shall be replaced or repaired at the expense of the responsible party. Store clear of the ground and in such a manner as to eliminate excessive handling.
 - B. Store fasteners in a protected location. Clean and re-lubricate bolts and nuts before use.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Structural Steel:
 1. All structural steel shall be free from defects impairing strength, durability or appearance. All structural steel shall meet the latest minimum requirements as follows:
 - a. Structural steel shapes, bars and plates shall conform to the ASTM designations listed in the General Notes of the Drawings.
 - b. Square and rectangular structural tubing shall be cold formed conforming to the ASTM designations listed in the General Notes of the Drawings.
 - c. Round structural tubing shall be cold formed conforming to the ASTM designations listed in the General Notes of the Drawings.
 - d. Steel pipe shall conform to the ASTM designations listed in the General Notes of the Drawings.
- B. High Strength Structural Bolts:
 1. High strength structural bolts shall conform to the ASTM designations listed in the General Notes of the Drawings.

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2. High strength bolts shall be detailed and installed in accordance with AISC - "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
 3. Manufacturer's symbol and grade markings shall appear on all bolts and nuts.
- C. Anchoring Devices:
1. Anchor Rods: Anchor rods used with structural steel members shall be plain threaded rods conforming to the ASTM designations listed in the General Notes of the Drawings.
 2. Expansion Anchors: Expansion anchors shall consist of one-piece wedge type carbon steel anchors with heavy-duty nuts and washers. All components shall be zinc plated in accordance with ASTM B633. Refer to the drawing details and General Notes for the expansion anchors used as the basis of design and the acceptable alternates.
 3. Adhesive Anchoring System: Adhesive anchoring system shall consist of a threaded anchor rod complete with nut and washer and the adhesive cartridge. Refer to the drawing details and General Notes for the adhesive anchoring systems used as the basis of design and the acceptable alternates.
 - a. Nuts shall meet ASTM A563, Grade DH, and washers shall meet ASTM F436.
 - b. All components shall be zinc plated in accordance with ASTM B633 SC1.
 - c. Adhesive shall consist of a two-part acrylic based adhesive applied in a dual cartridge dispensing system that properly mixes the components at the point of application.
- D. Welding Materials:
1. Type required for material being welded in conformance with AWS D1.1.
- E. Stud Connectors:
1. For threaded studs that are being used to connect steel beams to embed plates, use ASTM A108, Type A, Grades 1010 through 1020 forged steel, headed uncoated with a minimum tensile strength of 61,000 psi. Fabricated within the tolerances set forth in AWS D1.1.
 2. For shear connectors that are being used on steel beams in concrete slabs for composite shear transfer and embedded steel members, use ASTM A108, Type B, Grades 1010 through 1020 forged steel, headed uncoated with a minimum tensile strength of 65,000 psi. Fabricated within the tolerances set forth in AWS D1.1
 3. Studs applied by means of the electric arc welding process and shall use an arc shield ferrules of heat resistant ceramic.
- F. Paints and Primers:
1. Fabricator's standard lead- and chromate-free, non-asphaltic, rust-inhibiting primer.
 2. Galvanizing repair paint: SSPC Paint 20.
 3. Refer to Specification Section 09 90 00 for additional paint requirements.
- G. Non-Shrink Grout for Base and Bearing Plates: Non-shrink grout, conforming to ASTM C1107, shall be pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sand, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents. All constituents shall meet the requirements of these specifications. Minimum compressive strength at 28-days shall be 7,000 psi as determined by ASTM C109. Follow manufacturer's instructions for handling, mixing, placing and curing. Acceptable products are:

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1. Euclid Chemical Company - Euco N.S. Grout
 2. L&M Construction Chemical - Crystex.
 3. Master Builders - Masterflow 713.
 4. Sonneborn - SonnogROUT.
 5. Five Star Products Inc. – Five Star Grout.
 6. Dayton Superior - Sure-Grip High Performance Grout.
 7. Dayton Superior – 1107 Advantage Grout.

2.2 FABRICATION AND MANUFACTURE

A. Fabrication Procedures:

1. Fabricate all structural steel items in accordance with AISC Specifications and as indicated on the drawings.
2. Provide camber in structural members where indicated.
3. Properly mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize handling of materials.
4. Complete structural steel assemblies before shop priming or galvanizing.

B. Shop Connections:

1. All shop connections shall be welded, unless noted otherwise on drawings. Connections shall develop the full strength of the adjoining members unless detailed otherwise.
2. All holes shall be either drilled or punched, as no burning of holes will be permitted, including the enlargement of holes. Provide all holes required for connections and for attaching the work of other trades where such holes are shown if furnished prior to fabrication.
3. Connections shall be detailed as standard framed beam connections (bearing type) in accordance with the AISC Manual of Steel Construction - Allowable Stress Design. Connections which require oversized holes or slotted holes in which the force is other than normal to the axis of the slot shall be detailed as "Slip-Critical Connections" and noted as such on the erection drawings. Provide bearing plates and end anchorage for beams resting on masonry.
4. All full and partial penetration welds shall be fully detailed on the shop drawings. Use backing for all full penetration welds.
5. Weld access holes shall be fabricated in accordance with the recommendations of AWS D1.1 and AISC Specification.

C. Shear Connectors:

1. Steel stud shear connectors shall be securely welded in the field to structural steel beams as detailed on the drawings. Welds shall be such that the shear connector stud will deform before weld failure occurs. Welding shall be done in accordance with AWS D1.1.
2. Shear stud connector for embedded plates and angles shall be welded in the fabrication shop in accordance with AWS D1.1.

D. Deck support framing and seats: Furnish all miscellaneous framing necessary to fully support the roof and floor steel decking.

E. Shop Priming:

1. Unless noted otherwise below, structural steel shall not be shop primed.

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2. The following are steel surfaces to receive shop priming:
 - a. Surfaces outside the building envelope that are not galvanized, including the following:
 - 1) Covered canopies.
 - b. Surfaces to be painted per Architect's drawings.
 3. If the steel pieces are to be shop primed, the following surfaces are exceptions to shop priming:
 - a. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - b. Surfaces to be field welded.
 - c. Surfaces to be high-strength bolted with slip-critical connections.
 - d. Top flanges of beams supporting composite steel decking.
 - e. Surfaces to receive sprayed fire-resistive materials.
 - f. Galvanized surfaces.
 4. Surface Preparation: Clean Surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - a. SSPC-SP3, "Power Tool Cleaning."
 5. Priming: Apply primer in accordance with paint manufacturer's recommendations, and at a rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
- F. Finished Paint System:
1. Finished paint coats shall be in accordance with paint manufacturer's recommendations, and specification Division 9.
 2. Paint shall be free of sags, runs, drips or other defects. Allow ample drying time before handling to prevent damage to coatings.
 3. Strip paint corners, crevices, bolts, welds, and sharp edges.
 4. Apply one coat of shop paint to surfaces that will be inaccessible after assembly or erection.
- G. Galvanizing:
1. Hot-Dip Galvanized Finish: Apply Zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - a. Fill vent holes and grind smooth after galvanizing.
 - b. Unless otherwise noted on drawings or in Division 9, all exterior steel components exposed to the elements shall be galvanized, including, but not limited to, lintels.

2.3 LEED CREDIT

- A. LEED Credit MRC 4.2:

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1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.
 2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.
- B. LEED Credit MRc 5.1/5.2:
1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 ERECTION

A. Erection Procedures:

1. The erector and not the structural engineer of record shall be responsible for the means, methods and safety of erection of the structural steel framing.
2. Erection of all structural steel items shall meet the requirements of AISC "Specification and Code of Standard Practice."
3. All work shall be erected square, plumb, straight and true, accurately fitted and with tight joints and intersections, by mechanics experienced in the erection of structural steel. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
4. All base plates shall be supported on steel wedges, steel shims or heavy duty leveling nuts until the supported members have been leveled and plumbed.
 - a. Snug tighten anchor rods after supported members have been positioned and plumb. Do not remove wedges or shims but, if protruding, cut off flush with edge of base plate before packing with grout.
 - b. Promptly place non-shrink grout between bearing surfaces and base plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturers written installation instructions for shrinkage-resistant grouts.
5. Field connections of structural work shall be made with either high strength bolts (bearing type) or by welding. Proper precaution shall be taken to ensure that anchored items will not be distorted or overstressed due to improperly fabricated items.
6. Splice members only where indicated.
7. Do not use thermal cutting during erection unless approved by the Engineer/Architect in writing.
8. Steel erection shall not proceed without concrete in footings, piers, and walls attaining 75% of the intended minimum compressive design strength. Documentation must be provided indicating compliance with this requirement.

B. Bracing and Protection:

1. Steel shall be well plumbed, leveled and braced to prevent any movement.

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- a. Contractor shall provide and maintain all necessary temporary guying of steel frame to resist safely all wind and construction loads during erection and to assure proper alignment of all parts of the steel frame.
 - 2. Provide all temporary flooring, bracing, shoring and guards necessary to prevent damage or injury. All partially erected steel shall be secured in an approved manner during interruptions of work.
 - C. Anchor and Foundation Rods:
 - 1. All anchor or foundation rods and similar steel items to be built into concrete or masonry are to be set by the concrete or masonry contractors and shall be furnished promptly so that they may be built in as the work progresses because cutting of structural steel members to accommodate errors pertaining to embedded items will not be permitted.
- 3.2 FIELD WELDING
- A. Welding Procedures:
 - 1. All field welding shall be in accordance with AISC Specifications and conform to AWS D1.1 "Structural Welding Code - Steel".
 - a. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 - b. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice" for Steel Buildings and Bridges" for mill material.
 - 2. Contractor shall remove ceramic ferrules from shear connectors in sufficient time so as to allow for inspection of welds prior to placement of the concrete.
- 3.3 REPAIRS, PROTECTION, AND TOUCH UP
- A. Repair damaged galvanized coatings and on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
 - B. Touch up Painting: After installation, promptly clean, prepare, and prime or reprime field welds, final connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP2 hand-tool cleaning or SSPC-SP3 power-tool cleaning.
 - 2. Apply a compatible primer of the same type as shop primer used on adjacent surfaces.
- 3.4 GROUTING
- A. Grouting under structural framing members shall be completed after all members have been plumbed and braced and before imposed loads are placed thereon.
 - B. Remove all defective concrete, dirt, oil, grease and other foreign matter from surfaces to which grout will be placed.
- 3.5 MISCELLANEOUS STEEL AND STEEL LINTELS
- A. Furnish and install all miscellaneous steel as detailed in Architectural and Structural Drawings.

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- B. The steel fabricator shall furnish all steel lintels required for masonry wall construction indicated in the Architectural and Structural Drawings and Schedules.
 - C. Provide additional steel framing for continuous support of steel deck edges at openings and column interruptions.
 - D. All exterior exposed steel shall be hot-dip galvanized in accordance with ASTM A123.

END OF SECTION 05 12 23

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SECTION 05 21 00 - STEEL JOISTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section includes the fabrication and erection of open web steel joists. Work shall include but not be limited to, the following items:
 - 1. K-series joists.
 - 2. Joist substitutes.
 - 3. Bridging.
 - 4. Joist anchors and connections.
- C. Perform work in accordance with SJI Standard Specifications, Load Tables, and Weight Tables for Steel Joist and Joist Girders.
- D. Structural notes indicated on drawings regarding steel joists shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.
 - 1. AISC – Load and Resistance Factor Design Specification for Structural Steel Buildings, 2nd Edition.
 - 2. AISC – Specification for Structural Steel Building – Allowable Stress Design Plastic Design, 9th Edition.
 - 3. AISC 360-05 – Specification for Structural Steel Buildings – Allowable Strength Design, 13th Edition.
 - 4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
 - 5. ASTM A153 - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
 - 6. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 - 7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 8. ASTM A36 – Standard Specification for Carbon Structural Steel
 - 9. ASTM A572 - Standard Specification for High Strength, Low-Alloy Columbium-Vanadium Structural Steel
 - 10. AWS D1.1 - Structural Welding Code.
 - 11. SJI – Standard Specification for Open Web Steel Joists, K-Series
 - 12. SSPC - Steel Structures Painting Council.
- B. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.
4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per approved testing and inspection program.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency’s knowledge in conformance with the approved plans and specifications.
5. Structural Component Testing and Inspection Schedule for Section 05 21 00 is as follows:

Structural Steel Joists	Continuous	Periodic	Referenced Standard
1. Material verification of structural steel:			
A. For structural steel, identification markings to conform to AISC 360		X	AISC 360, Section M5.5
B. Identification markings to conform to ASTM standards specified in the approved construction documents.		X	Applicable ASTM material standards
C. Manufacturer’s certified test reports.		X	
2. Material verification of weld filler materials:			
A. Identification markings to conform to AWS specification in the approved construction documents.		X	AISC 360, Section A3.5 and applicable AWS A5 documents
B. Manufacturer’s certificate of compliance required.		X	
3. Inspection of welding:			
A. Complete and partial penetration groove welds.	X		AWS D1.1
B. Multi-pass fillet welds.	X		AWS D1.1
C. Single-pass fillet welds > 5/16” (7.9 mm)	X		AWS D1.1
D. Plug and slot welds.	X		AWS D1.1
E. Single-pass fillet welds ≤ 5/16” (7.9 mm)		X	AWS D1.1
4. Inspection of steel frame joint details for compliance:			
A. Details such as bracing and stiffening.		X	
B. Member locations.		X	
C. Application of joint details at each connection.		X	

1.4 SUBMITTALS

- A. Prepare and submit shop and erection drawings for Engineer's approval.
- B. Shop Drawings:
 - 1. Indicate standard designations, configuration, sizes, spacing, location of joists, joist chord extensions.
 - 2. Joining and anchorage details of attachment to other construction.
 - 3. Size, location and configuration of all code required bridging, bracing and connections.
 - 4. Joist cambers.
 - 5. Type of paint and shop primer.
- C. Welder's Certificates: Submit certification for all welders employed on the project demonstrating they have been AWS qualified to perform the welding procedures required for this project.
- D. LEED Certification: Submit manufacturer's certification for each steel product including the following:
 - 1. LEED Credit MRc 4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.
 - 2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in performing the work of this section with minimum ten (10) years documented experience. Fabrication Company shall be certified by the Steel Joist Institute (SJI) to manufacture joists complying with the SJI Standard Specifications and Load Tables.
- B. Manufacturer shall assume responsibility for engineering special joists indicated on the Drawings to comply with the SJI standard specification performance requirements. This responsibility includes the preparation of Shop Drawings and comprehensive engineering analysis by a qualified structural engineer licensed in the state where the project is located.
- C. Erector: Company specializing in performing the work of this section with minimum five (5) years documented experience.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All joists and accessories shall be transported, stored and erected in a manner, which will prevent any damage or deformation. Damaged joists shall not be erected or repaired without Structural Engineer's approval. Joists shall be stored clear of the ground in such a manner so as to eliminate excessive handling, and protect from weather with a weatherproof covering.
- B. Deliver and store all joists and accessories to the site according to all SJI requirements.

1.7 FIELD MEASUREMENTS

- A. Verify that field measurements are as shown on the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Bar Joists: Steel used in the manufacture of bar joists shall be as allowed by the Steel Joist Institute (SJI) standard specification for chord and web members.
- B. High Strength Bolts and Nuts: ASTM A325, Type 1 heavy hex steel structural bolts, heavy hex carbon steel nuts, and hardened carbon steel washers. Finish shall be plain, uncoated.
- C. Carbon Steel Bolts and Threaded Fasteners: ASTM A307, Grade A, carbon steel, hex head bolts and threaded fasteners; carbon steel nuts; and flat unhardened steel washers. Finish shall be plain, uncoated mechanically deposited zinc coating, ASTM B695, Class 50.
- D. Miscellaneous items, such as bridging, headers, bolts, nuts, washers, anchors and all other appurtenances for a complete metal joist installation shall be furnished as a part of the work of this section.
- E. Primer: Provide the manufacturer's standard shop primer with good resistance to normal atmospheric corrosion and complying with the performance requirements specified in the SJI "Standard Specification" previously cited.
 - 1. Do not prime paint joists and accessories scheduled to receive spray applied fireproofing.
 - 2. Contractor shall certify compatibility of shop primer coat with field applied paint finishes.
- F. Welding Materials: AWS D1.1; type required for materials being welded.

2.2 FABRICATION AND MANUFACTURE

- A. Manufacture K-Series steel joists according to "Standard Specification for Open Web Steel Joists, K-Series," in SJI "Specifications," with steel angle top and bottom chord members, underslung ends, and parallel top chords; of joist type indicated.
- B. All steel joists shall consist of an electrically welded open-web type, designed and fabricated to conform to the "Standard Specifications" included in the SJI or AISC publications cited above and shall be manufactured by a current member of the Steel Joist Institute.
- C. Provide holes in chord members for connecting and securing other construction to joists. General Contractor shall coordinate this information and provide the manufacturer with drawings outlining the location of any required holes.
- D. Bridging members for open web joists, unless otherwise indicated on the drawings, shall be continuous wall to wall, complete with suitable anchorage at each end, all in accordance with SJI "Standard Specifications".
- E. Design and fabricate joists and bridging to support a minimum net uplift as indicated on the drawings. A 1/3 stress increase shall not be used in uplift design.
- F. Do not camber joists.
- G. Header members to support joist ends where openings must be framed through the structure shall be provided for all open web joists.
- H. All steel joists including all accessories, before leaving the shop shall be thoroughly cleaned of all mill scale, rust and foreign matter and shall be given one (1) coat of primer complying with the performance requirements specified in the SJI "Standard Specification" previously cited.
- I. Provide bottom and top chord extensions as indicated on the Drawings. Top chord extensions shall be SJI's Type S.

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- J. Provide extended bearing ends of joists with SJI's Type R extended ends where indicated on the Drawings.

2.3 CLEANING, PRIMING AND PAINTING

- A. Clean joist by using solvent cleaning, SSPC-SP 1 to remove oil and grease.
- B. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous dry film thickness of not less than 1 mil.
- C. Painting of joists and joist accessories is specified in Division 9 Section "Painting."

2.4 LEED CREDIT

- A. LEED Credit MRc 4.2:
 - 1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.
 - 2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.
- B. LEED Credit MRc 5.1/5.2:
 - 1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 ERECTION

- A. Erection of all metal joist items shall meet the applicable requirements of the SJI "Standard Specifications" previously cited.
- B. All anchor bolts, wall anchors, bridging anchors, bearing plates and similar items to be built into concrete or masonry are to be set by the concrete or masonry contractors and shall be furnished promptly so that they may be built-in as the work progresses as no cutting for the same afterward will be permitted. Beginning of installation means erector accepts existing conditions.
- C. All metal joists shall be accurately set to the lines, elevations and dimensions indicated on the approved shop drawings.
- D. Bridging shall be installed concurrently with joist erection and before loads are applied. Bridging shall be securely welded to joist chords in a manner that will not damage joist members and so as to insure positive resistance to both tensile and compressive stresses. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.
- E. All K-series joists must bear a minimum of 4 inches on masonry or concrete surfaces and a minimum of 2-1/2 inches on steel surfaces. All joists bearing on concrete or masonry shall bear on a steel bearing plate and joists bearing on steel shall be welded to the supporting steel.
- F. K-series joists shall be anchored at a minimum with (2) 1/8" fillet welds (1" long) at each support, or (2) 1/2" diameter bolts.
- G. All field welding shall be in accordance with AWS previously cited.

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- H. All construction loads shall be kept off joists until they are permanently anchored and bridged. During construction, care shall be taken to avoid excessive concentrated or moving loads. Provide for adequate distribution of any such loads so that the carrying capacity of the joists is not exceeded.
 - I. Joist shall not be positioned any greater than 1/4 inch from true alignment, and shall not vary more than 1/4 inch from plumb.

3.2 FIELD TOUCH UP

- A. Immediately after erection, Contractor shall touch up all erection bolts, all field welds and all scratched or abraded areas and paint out erection markings with matching rust-inhibitive primer in color and formulation to match shop primer.

END OF SECTION 05 21 00

SECTION 05 31 00 - STEEL DECK

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section includes the fabrication and erection of steel deck. The Work shall include, but not be limited to the following:
 - 1. Roof deck, roof deck accessories, and roof deck fasteners.
 - 2. Composite floor deck.
- C. Structural notes indicated on the drawings regarding steel decking shall be considered a part of this specification.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.
 - 1. AISI - Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. ANSI/AWS D1.1 - Structural Welding Code.
 - 3. ANSI/AWS D1.3 - Structural Welding Code - Sheet Steel.
 - 4. ASTM A1008- Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled
 - 5. ASTM A36 – Standard Specification for Carbon Structural Steel.
 - 6. ASTM A653 - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
 - 7. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
 - 8. SDI - Design Manual for Composite Decks, Form Decks, Roof Decks by the Steel Deck Institute.
- B. Manufacture steel decking in accordance with the Steel Deck Institute's (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks".
- C. All steel deck shall be designed and fabricated in accordance with the above AISI and SDI specifications. The gauges and section moduli indicated on the drawings or specified herein are minimum and the gauge and section modules of the deck furnished shall meet or exceed these minimum requirements. All gauges are United States standard, measured prior to coating.
- D. Contractor to verify that the manufacturer's steel deck type selected is listed on the UL fire rated roof assembly specified by the Architect for this project.
- E. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.

- F. Contractor to have pre-installation meeting where installer demonstrates workmanship by conducting representative fastenings at pre-installation meeting, subject to guidance from mechanical fastener manufacturer representative.

1.3 TESTING AND INSPECTION

A. Inspection and Testing:

1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.
4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per approved testing and inspection program.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency’s knowledge in conformance with the approved plans and specifications.
5. Structural Component Testing and Inspection Schedule for Section 05 31 00 is as follows:

Steel Deck	Continuous	Periodic	Referenced Standard
1. Material verification of cold-formed steel deck:			
A. Identification markings to conform to ASTM standards specified in the approved construction documents.		X	Applicable ASTM material standards
B. Manufacturer’s certified test reports.		X	
2. Inspection of welding:			
A. Floor and roof deck welds		X	AWS D1.3

1.4 QUALIFICATIONS

- A. Fabricator: Company specializing in performing the work of this section with minimum five (5) years documented experience at manufacturing steel deck. Fabrication Company shall be a current member of the Steel Deck Institute (SDI).
- B. Erector: Company specializing in performing the work of this section with minimum five (5) years documented experience at erecting steel deck.

1.5 SUBMITTALS

- A. Prepare and submit shop drawings for Engineer's approval. Shop drawings shall indicate deck layout, depth, uncoated metal thickness, framing and supports with unit dimensions and sections and complete end jointing.
- B. Provide details of all accessories.
- C. Shop drawings shall also indicate typical welding or mechanical anchoring pattern for steel deck and accessories.
- D. Prepare and submit allowable construction span tables and allowable total load tables for Engineer's approval. Tables shall be accompanied with a letter of certification from the manufacturer stating the tabulated design values were determined in accordance with the steel deck institute's "Design Manual for Composite Decks, Form Decks, and Roof Decks."
- E. Provide manufacturer's latest recommendations and installation instructions.
- F. Prepare and submit product data of proposed materials.
- G. LEED Certification: Submit manufacturer's certification for each steel product including the following:
 - 1. LEED Credit MRc 4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.
 - 2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All decking materials shall be transported, stored and erected in a manner that will prevent damage or deformation of sheets. Damaged material shall not be erected or repaired without Structural Engineer's approval.
- B. Deck panels shall be stored clear of the ground, elevated on one end, and protected from weather with waterproof covering.

PART 2 - PRODUCTS

2.1 STEEL ROOF DECK

- A. Standard Steel Roof Deck: Fabricate panels to comply with "SDI Specification and Commentary for Steel Roof Deck," and the following:
 - 1. Steel decking sheet material, minimum yield strength, depth, gage, profile, and finish are indicated on the Drawings, as classified by Steel Deck Institute (SDI). Panels shall be formed with integral ribs and overlapping side flanges.

2.2 COMPOSITE FLOOR DECK

- A. Composite Floor Deck: Fabricate panels with integrally embossed or raised pattern ribs to comply with "SDI Specification and Commentary for Composite Steel Floor Deck," and the following:
 - 1. Steel decking sheet material, minimum yield strength, depth, gage, profile, and finish are indicated on the Drawings, as classified by Steel Deck Institute (SDI). Panels shall be formed with integral ribs and overlapping side flanges.

2.3 FASTENERS

A. Support Fasteners:

1. Welded: 5/8" diameter electric arc spot (puddle) welds. Refer to Drawings for weld spacing requirements.
 - a. Weld washers required for material less than 0.028" thick. Welding washers shall a minimum thickness of 0.0598 inches and be applicable to AWS D1.3 type welding and of type as recommended by the deck manufacturer.
 - b. Weld metal shall penetrate all layers of deck material and shall have good fusion to the supporting steel. Fasten ribbed deck to steel support members at ends and intermediate supports.
 - 1) All welding shall be in conformance with previously cited AWS recommendations in appearance and quality of welds, and the methods used in correcting welding work.

B. Side Lap Fasteners:

1. Mechanical: Zinc coated self-drilling, self-tapping type (minimum No. 10) steel screws. Refer to Drawings for fastener spacing requirements.

2.4 ACCESSORIES

- A. Provide all closers, fillers, starters, sump pans, metal cant strips, ridge and valley plates, pour stops, column closures, girder fillers, and similar accessories required for a complete installation. Provide cover plates at all locations where direction of deck span changes. Unless otherwise noted, accessories shall be of the same steel sheet material, finish, and thickness as the deck sections.
- B. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- C. Recessed Sump Pans: Single piece steel sheet of same material, finish and thickness as the deck, with 3 inch wide flanges and recessed pan of 1-1/2 inch minimum depth. Cut drain holes in the field.

2.5 LEED CREDIT

A. LEED Credit MRc 4.2:

1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.
2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 ERECTION

- A. Verify that field conditions are acceptable and are ready to receive work.

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- B. Deck units and deck accessories herein specified shall be thoroughly and securely erected by experienced workmen fastening to supporting steel members as herein specified. All work shall be in conformance with manufacturer's latest printed recommendations and approved shop drawings.
 - C. Beginning of installation means installer accepts existing conditions.
 - D. The finished work shall be true, flat planes and to slopes indicated with end joints flush and without sharp protruding edges. Exposed underside of deck shall be true without defect.
 - E. Erector shall cut all openings in deck for piping and equipment furnished by other trades. Wherever ribs are cut and are not supported by supplemental framing, the erector shall provide steel angles of adequate size on all sides of the opening welded to the underside of each rib.
 - F. Burning of holes in decking will not be permitted.
 - G. Steel decking shall be installed to span supporting steel members at right angles. Panels shall be securely anchored to each structural support it rests on or passes.

3.2 ROOF DECK

- A. Fasten roof deck panels to steel supporting members using welds and mechanical fasteners as specified herein and on the Drawings.
- B. Unless noted otherwise, secure side laps and perimeter edges of units with fasteners at mid-span between supports or 36 inches on center, whichever distance is smaller.
- C. Deck shall be fastened through the bottom of the deck rib to all structural supports for the specific deck sections.
- D. End bearing of roof decking shall have a minimum of 1-1/2 inches of bearing occurring over structural supports
- E. End joints shall be lapped 2 inches minimum.
- F. Install sound absorbing insulation into the topside ribs of the acoustical deck as specified in the deck manufacturer's installation instructions. Coordinate with the roofing installation to protect the insulation from damage.
- G. Place deck panels on structural supports and adjust to final position with ends aligned. Attach to supports immediately after placement.
- H. Roof sump pans shall be installed over openings provided in roof deck with flanges welded to the top of the deck. Space welds at 12 inches apart with at least 1 weld in each corner.
- I. Install all roof deck accessories in accordance with the roof deck manufacturer's written instructions.

3.3 FLOOR DECK

- A. Fasten steel floor deck to supporting steel with 5/8" diameter electric arc spot (puddle) welds spaced at 12" O.C. minimum. Secure side laps and perimeter edges of units with fasteners at mid-span between supports or 36 inches on center, whichever distance is smaller.
- B. Place deck panels on structural supports and adjust to final position with ends aligned. Attach to supports immediately after placement.
- C. Install deck ends over supports with a minimum end bearing of 1-1/2 inches.
- D. Non-composite decks end joints shall be lapped a minimum of 2 inches.

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- E. Install pour stops and girder fillers to supporting structure according to manufacturer's recommendations.
 - F. Fasten column closures and cell closures to deck to provide a tight fit. Provide cell closures at changes of direction of deck units, unless otherwise noted.
 - G. Install all floor deck accessories in accordance with the floor deck manufacturer's written instructions.
 - H. If steel studs shear connectors are being applied through the deck onto the structural steel for composite floor construction, the stud welds can be used to replace the specified puddle welds.
 - I. Composite deck sheets with shear stud connectors shall be butted over supporting members. Standard tolerance for ordered lengths is plus or minus ½ inch.

3.4 FIELD TOUCH UP

- A. After erection, all weld burn marks and abraded spots shall be cleaned and field painted with a rust-inhibiting metal primer matching formulations and color of shop coat or a zinc-rich rust inhibiting paint for galvanized deck surfaces.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED STEEL FRAMING (CFSF) SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. Load bearing structural steel studs and joist framing system of 20 to 12 gauge (33 mil to 97 mil) members along with fasteners and related accessories.
- C. Furnish and install cold-formed steel framing system as shown on Drawings and herein specified.
 - 1. Work shall include, but not be limited to the following items:
 - a. Bearing and non-load bearing formed steel stud exterior wall and interior non-load bearing wall framing.
 - b. Provide tracks, blocking, lintels, clips angles, bridging, shoes, reinforcements, fasteners and accessories to construct a complete steel framing system.
- D. Structural notes indicated on Drawings regarding cold-formed steel framing system shall be considered a part of this Specification.
- E. Refer to Division 9 for non-load bearing studs of 20 gauge (30 mil) or lighter.

1.2 QUALITY ASSURANCE

- A. Workmen Qualifications:
 - 1. For the actual erection of cold-formed steel framing system, use only skilled journeymen steel framing erectors who are thoroughly experienced with the materials and methods specified.
 - 2. Use qualified welders and comply with AWS standards.
- B. Codes and Standards: Comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:
 - 1. AISI - Specification for the Design of Cold Formed Steel Structural Members, Current Edition.
 - 2. AISI General Provisions 2004 Edition.
 - 3. AWCI - Association of Wall and Ceiling Industries, Current Edition.
 - 4. AWS D1.3 - Structural Welding Code - Sheet Steel
 - 5. ASTM A653 - Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
 - 6. ASTM A1008 -Structural Steel (SS), Sheet, Carbon, Cold-Rolled
 - 7. ASTM C955 - Load Bearing (Transverse and Axial) Steel Studs, Runners (Track) and Bracing or Bridging for Screw Applications of Gypsum Board and Metal Plaster Base.
 - 8. ASTM C1007 - Installation of Load Bearing Steel Studs and Related Accessories.

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9. SSMA - Steel Stud Manufacturers Association.
- C. Where any provisions of other pertinent codes and standards conflict with this specification, the more stringent provision shall govern.
- D. Performance Requirement:
1. Provide CFSF capable of withstanding design loads indicated on the plans.
 2. Design CFSF to withstand design loads meeting the following deflection limits:
 - a. Exterior walls backing up brick or stone veneer: Horizontal deflection of 1/600 of wall height.
 - b. Exterior walls clad with metal siding, exterior insulated finish systems or other flexible non-brittle finishes: Horizontal deflection of 1/360 of wall height.
 - c. Interior Non-Load Bearing Walls: Horizontal deflection of 1/360 of wall height under 5 psf load.
 3. Design CFSF to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120°F.
 4. Design system to accommodate construction tolerances, deflection of building structural members (1 inch maximum), and clearances of intended openings.
 5. CFSF shall be designed in accordance with "Standard for Cold-Formed Steel Framing - General Provisions", current edition.

1.3 TESTING AND INSPECTION

- A. Inspection and Testing:
1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
 2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
 3. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected per the table below. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specification to the building official and the Architect and Engineer of Record.
 4. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per approved testing and inspection program.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency's knowledge in conformance with the approved plans and specifications.

5. Structural Component Testing and Inspection Schedule for Section 05 40 00 is as follows:

Load Carrying Cold-Formed Structural Steel Studs	Continuous	Periodic	Referenced Standard	IBC Reference
1. Material verification of cold-formed steel:				
A. Identification markings to conform to ASTM standards specified in the approved construction documents.		X	Applicable ASTM material standards	
B. Manufacturer's certified test reports.		X		
2. Material verification of weld filler materials:				
A. Identification markings to conform to AWS specification in the approved construction documents.		X	Applicable AWS A5 documents	
B. Manufacturer's certificate of compliance required.		X		
3. Inspection of welding:				
A. Welding of cold-formed structural steel framing.		X	AWS D1.3	
4. Inspection of steel frame joint details for compliance:				
A. Details such as bracing and stiffening		X		1704.3.2
B. Member locations		X		1704.3.2
C. Application of joint details at each connection		X		1704.3.2

1.4 SUBMITTALS

A. Shop Drawings:

1. Prepare and submit complete erection and detailed shop drawings for Engineer's approval, including framing plans indicating size, gauge, weight and location of all framing members. Shop drawings shall indicate the following:
 - a. Component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, bracing, bridging, strapping, connections, and accessories or items required of other related work. Provide stud layout.
 - b. Describe method for securing studs to tracks and for bolted/welded framing connections.
 - c. Provide calculations for loadings and stresses of steel framing system, including specially fabricated components and roof trusses, shall be prepared by a registered professional engineer, with registration from the state in which the building is located.
 - d. Detail size and location of all bridging, strapping, bracing, splices, and accessories required for installation.

B. Product Data:

1. Provide product data on standard framing members. Describe materials and finish, product criteria and limitations. Submit manufacturer's installation instructions.

C. LEED Certification: Submit manufacturer's certification for each steel product including the following:

1. LEED Credit MRc 4.2 – Recycled content, including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer's name, product cost and steel processing furnace type.
2. LEED Credit MRc 5.1/5.2 – Location of manufacturing plant, manufacturer's name, product cost and location of extraction or harvest of raw materials.

1.5 QUALIFICATIONS

- A. MANUFACTURER: Company specializing in performing the work of this section with a minimum of five (5) years documented experience at manufacturing cold-formed steel and framing systems and related accessories. Manufacturer shall be a current and "full" member of the Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA).
- B. All steel studs and track furnished under this section shall be supplied by a manufacturer who is a current member of the Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA).
- C. Steel studs, headers, and other elements used for this project are sized based on SSMA. Elements of equal or greater capacity may be exchanged.
- D. Preparation of shop drawings, design calculations, and other structural data by a qualified Professional Engineer licensed in the State of Wisconsin.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Steel members shall be transported, stored and erected in a manner that will avoid any damage or deformation. Bent or deformed members will be rejected and shall be replaced or repaired at the expense of the responsible party. Store clear of ground and in such a manner so as to eliminate excessive handling.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Framing Materials:
 - 1. Studs shall be minimum 20 gauge (33 mil) thick sheet steel conforming to ASTM A653 Grade 33 for 18 gauge and thinner and/or Grade 50 for 16 gauge and thicker, formed to channel shape, punched web, with nominal size as indicated on Drawings.
 - 2. Track shall be minimum 20 gauge (33 mil) thick sheet steel, channel shaped, solid web, same width as above studs. Track shall provide a tight fit for studs.
- B. Accessories:
 - 1. Bracing, furring and bridging shall consist of formed sheet steel with thickness determined for conditions encountered. Provide manufacturer's standard shapes, complete with finish same as framing members.
 - 2. Plates, gussets and clips shall consist of formed sheet steel with thickness determined for conditions encountered. Provide manufacturer's standard shapes, complete with finish same as framing members.
- C. Fasteners:
 - 1. Self-drilling, self-tapping screws, bolts nuts and washers shall conform to ASTM A90, complete with hot-dip galvanized minimum size: 1/4-14.
 - 2. Expansion anchors shall be "Kwik" bolts, as manufactured by Hilti, Inc.
 - 3. All other fasteners shall be as indicated on Drawings or as recommended by the above stud manufacturer.

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4. Welding connections are to be performed in accordance with American Welding Society (AWS) D1.3 latest edition "Specification for Welded Sheet Steel in Structures." Consult AWS D19.0 latest edition "Welding Zinc Coated Sheet" and ANSI Standard Z49.1 for information regarding welding procedures.

D. Finishes:

1. Furnish all studs and system components with a factory galvanized (G60) or prime coat finish.

2.2 FABRICATION

- A. Fabricate assemblies of framed sections, of sizes and profiles required with framing members fitted, reinforced and braced to suit design requirements.
- B. Fit and assemble in largest practical sections for delivery to Worksite, ready for installation.
- C. Bearing studs must be fabricated with full stud end seated against track web. Do not use studs that have been cut at punchouts.

2.3 LEED CREDIT

A. LEED Credit MRc 4.2:

1. Steel products shall be made using an Electric Arc Furnace and shall have a minimum recycled content of 80%, including at least 65% post-consumer recycled content and 15% post-industrial recycled content.
2. Steel products made using a Basic Oxygen Furnace shall have a minimum recycled content of 25%, including at least 20% post-consumer recycled content and 5% post-industrial recycled content.

B. LEED Credit MRc 5.1/5.2:

1. Steel products shall be manufactured within 500 miles of project site. Recycled scrap products shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that substrate surfaces and building framing components are ready to receive work.
- B. Beginning of installation means acceptance of existing conditions and substrate.

3.2 INSTALLATION

A. General:

1. Cold-formed steel framing system shall consist of structural steel studs with locations as shown on Drawings. All work shall be in accordance with approved shop drawings and manufacturer's latest printed specifications. Framing members shall be securely attached by mechanical fasteners as indicated on Drawings and as recommended by the manufacturer.
 - a. All field welding shall be in accordance with AWS previously cited.
 - b. Wire tying of stud or joist components in system will not be allowed.
 - c. Complete framing system ready to receive subsequent facing material.

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2. Provision shall be made in studs for rigid fastening of all blocking and special braces or framing and for attachment and support of electrical outlets or other equipment indicated to be supported by stud construction.
 - a. All anchorage, bracing and blocking shall be in accordance with approved shop drawings and as recommended by the manufacturer.
 3. Surfaces abraded by handling, weld locations and other miscellaneous defects shall be touched-up with zinc-rich galvanizing compound (ZRC) coating.
- B. Erection Of Studding:
1. Top and bottom runner members shall be the same size and gauge as the stud and be continuous for the total length of framing system or as long as practical and shall be securely attached a maximum of 24 inches on centers with approved fastening devices. Studs shall extend in one piece full height vertically between runners, spaced no greater than 24 inches on centers, with all web cut-outs in perfect alignment. Studs shall provide solid backing at corners and jambs. Install joists with all components property aligned and braced with all work plumb and true ready and acceptable to receive surface materials.
 - a. Coordinate installation of sealant with floor and ceiling tracks.
 - b. Field cutting of studs shall be done by sawing.
 - c. Splices in axial load studs will not be permitted.
 - d. Erect load bearing studs, brace and reinforce to develop full strength to meet design requirements.
 - e. Extend stud framing through ceiling to underside of floor or roof structure above.
 - f. Install intermediate studs above and below openings with studs equally spaced to correspond to adjacent stud spacing.
 - g. Provide deflection allowance in stud track, directly below horizontal building framing for non-load bearing framing.
 - h. Framing fabricator shall ensure punchout alignment when assembling framing and field cutting to length.
 - i. All framing components shall be cut squarely for attachment to perpendicular members.
 - j. In the event a track butt joint occurs within a panel, abutting pieces of track shall be butt welded or spliced together. No such splices shall occur at any head or sill condition.
 2. Steel studs shall be located not more than 2 inches from all door, abutting partitions, partition corners and other construction. Unless detailed otherwise, runner track or stud member shall be used as a runner over door frames. Structural studs and joists shall be securely and rigidly anchored in place to give a total and complete support to subsequent materials attached thereto. All studs shall be securely attached to jamb and head anchor clips of each door frame by manufacturer's recommended method.
 - a. Construct corners using minimum three studs. Jamb studs at doors, windows, and other wall openings shall be designed to resist the tributary load of the opening and meet specified performance requirements.
 - b. Cold-rolled steel channel stiffeners or bridging shall be provided and installed horizontally every 60 inches in all framing systems through stud web cut-outs with welding clips welded in place at each stud.

END OF SECTION 05 40 00

1 SECTION 055000 - METAL FABRICATIONS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Steel framing and supports for overhead doors.
9 2. Steel tube reinforcement for low partitions.
10 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
11 4. Steel shapes for supporting elevator door sills.
12 5. Metal ladders.
13 6. Metal bollards.

- 14 B. Products furnished, but not installed, under this Section include the following:

- 15 1. Loose steel lintels.
16 2. Anchor bolts and steel pipe sleeves indicated to be cast into concrete or built into unit masonry.

- 17 C. Related Requirements:

- 18 1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, and other items cast
19 into concrete.
20 2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit
21 masonry.
22 3. Section 051200 "Structural Steel Framing."

23 1.3 COORDINATION

- 24 A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating
25 manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one
26 another.

- 27 B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting
28 drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and
29 items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in
30 time for installation.

31 1.4 ACTION SUBMITTALS

- 32 A. Product Data: For the following:

- 33 1. Paint products.
34 2. Grout.

- 1 B. Sustainable Design Submittals:
2
3 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
4 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
5 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
6 material, and fraction by weight that is considered regional.
7 2. Product Data for Credit MR 5: Indicating percentages by weight of postconsumer and preconsumer
8 recycled content for products having recycled content. Include statement indicating costs for each product
9 having recycled content.
- 10 C. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal
11 fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
- 12 1. Steel framing and supports for overhead doors.
13 2. Steel tube reinforcement for low partitions.
14 3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
15 4. Steel shapes for supporting elevator door sills.
16 5. Metal ladders.
17 6. Metal bollards.
18 7. Loose steel lintels.
- 19 D. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional
20 engineer responsible for their preparation.
- 21 1.5 INFORMATIONAL SUBMITTALS
- 22 A. Qualification Data: For professional engineer.
23 B. Welding certificates.
24 C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop
25 primers are compatible with topcoats.
26 D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.
- 27 1.6 QUALITY ASSURANCE
- 28 A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code
29 - Steel."
- 30 1.7 FIELD CONDITIONS
- 31 A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by
32 field measurements before fabrication.
- 33 PART 2 - PRODUCTS
- 34 2.1 METALS
- 35 A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal
36 fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled
37 trade names, or blemishes.

- 1 B. Recycled Content of Steel Products: Provide products with average recycled content of steel products so
2 postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.
- 3 C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 4 D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or
5 ASTM A 283/A 283M, Grade C or D.
- 6 E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.
- 7 F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

8 2.2 FASTENERS

- 9 A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated
10 fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior
11 walls. Select fasteners for type, grade, and class required.
- 12 B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with
13 hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- 14 C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M);
15 with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).
- 16 D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where
17 indicated, flat washers.
- 18 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to
19 be galvanized.
- 20 E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
- 21 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or
22 ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
- 23 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel
24 bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

25 2.3 MISCELLANEOUS MATERIALS

- 26 A. Shop Primers: Provide primers that comply with Division 09 painting Sections
- 27 B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints
28 specified to be used over it.
- 29 C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- 30 D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with
31 ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior
32 applications.
- 33 E. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained,
34 concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

- 1 2.4 FABRICATION, GENERAL
- 2 A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for
3 shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark
4 units for reassembly and coordinated installation.
- 5 B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32
6 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- 7 C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- 8 D. Form exposed work with accurate angles and surfaces and straight edges.
- 9 E. Weld corners and seams continuously to comply with the following:
- 10 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base
11 metals.
- 12 2. Obtain fusion without undercut or overlap.
- 13 3. Remove welding flux immediately.
- 14 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows
15 after finishing and contour of welded surface matches that of adjacent surface.
- 16 F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where
17 possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise
18 indicated. Locate joints where least conspicuous.
- 19 G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep
20 holes where water may accumulate.
- 21 H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- 22 I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure
23 metal fabrications rigidly in place and to support indicated loads.
- 24 J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap
25 anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm)
26 hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise
27 indicated.
- 28 2.5 MISCELLANEOUS FRAMING AND SUPPORTS
- 29 A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- 30 B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to
31 sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- 32 1. Furnish inserts for units installed after concrete is placed.
- 33 C. Galvanize miscellaneous framing and supports where indicated.
- 34 D. Prime miscellaneous framing and supports where indicated.
- 35 2.6 METAL LADDERS
- 36 A. General:

- 1 1. Comply with ASME A17.1/CSA B44.
- 2 B. Steel Ladders:
- 3 1. Space siderails 18 inches apart unless otherwise indicated.
- 4 2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
- 5 3. Rungs: 3/4-inch- diameter steel bars.
- 6 4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
- 7 5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
- 8 6. Support each ladder at top and bottom and not more than 24 inches o.c. with welded or bolted steel brackets.
- 9 7. Prime ladders, including brackets and fasteners.
- 10
- 11
- 12 2.7 METAL BOLLARDS
- 13 A. Fabricate metal bollards from Schedule 40 steel pipe.
- 14
- 15 B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- (6.4-mm-) thick steel plate welded to bottom
- 16 of sleeve. Make sleeves not less than 8 inches (200 mm) deep and 3/4 inch (19 mm) larger than OD of bollard.
- 17 C. Prime bollards.
- 18 2.8 LOOSE BEARING AND LEVELING PLATES
- 19 A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to
- 20 receive anchor bolts and for grouting.
- 21 B. Galvanize plates.
- 22 2.9 LOOSE STEEL LINTELS
- 23 A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry
- 24 walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated.
- 25 Weld adjoining members together to form a single unit where indicated.
- 26 B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8
- 27 inches (200 mm) unless otherwise indicated.
- 28 C. Galvanize loose steel lintels located in exterior walls.
- 29 2.10 FINISHES, GENERAL
- 30 A. Finish metal fabrications after assembly.
- 31 B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

- 1 2.11 STEEL AND IRON FINISHES
- 2 A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware
3 and with ASTM A 123/A 123M for other steel and iron products.
- 4 B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete,
5 sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- 6 C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
- 7 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
8 2. Other Items: SSPC-SP 3, "Power Tool Cleaning."

9 PART 3 - EXECUTION

10 3.1 INSTALLATION, GENERAL

- 11 A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set
12 metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and
13 free of rack; and measured from established lines and levels.
- 14 B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as
15 exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces
16 of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- 17 C. Field Welding: Comply with the following requirements:
- 18 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base
19 metals.
20 2. Obtain fusion without undercut or overlap.
21 3. Remove welding flux immediately.
22 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows
23 after finishing and contour of welded surface matches that of adjacent surface.
- 24 D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required
25 to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts,
26 toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- 27 E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar
28 construction.

29 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- 30 A. General: Install framing and supports to comply with requirements of items being supported, including
31 manufacturers' written instructions and requirements indicated on Shop Drawings.
- 32 B. Anchor supports for overhead doors securely to, and rigidly brace from, building structure.

33 3.3 INSTALLING METAL BOLLARDS

- 34 A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1 B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete not less than 8 inches deep and
2 3/4 inch (19 mm) larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed
3 and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch (3 mm)
4 toward bollard.

5 C. Fill bollards solidly with concrete, mounding top surface to shed water.

6 3.4 INSTALLING BEARING AND LEVELING PLATES

7 A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to
8 surfaces. Clean bottom surface of plates.

9 B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and
10 plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing
11 plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no
12 voids remain.

13 3.5 ADJUSTING AND CLEANING

14 A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint
15 uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for
16 touching up shop-painted surfaces.

17 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

18 B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with
19 ASTM A 780/A 780M.

20 END OF SECTION 055000

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1 SECTION 055113 – METAL PAN STAIRS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Preassembled steel stairs with concrete-filled treads.
9 2. Steel tube railings attached to metal stairs.
10 3. Steel tube handrails attached to walls adjacent to metal stairs.
11 4. Exterior steel tube handrails.
12 5. Railing gates at the level of exit discharge.

13 B. Related Requirements:

- 14 1. Section 033000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.

15 1.3 COORDINATION

- 16 A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating
17 manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one
18 another.

- 19 B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for
20 installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to
21 be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- 22 C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width
23 and are within the fire-resistance-rated stair enclosure.

24 1.4 ACTION SUBMITTALS

25 A. Product Data: For metal pan stairs and the following:

- 26 1. Prefilled metal-pan-stair treads.
27 2. Paint products.

28 B. Sustainable Design Submittals

- 29
30 1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and
31 preconsumer recycled content for products having recycled content. Include statement indicating costs for
32 each product having recycled content.

- 1 2. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply
- 2 with requirements for regional materials, certificates indicating location of material manufacturer and point
- 3 of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project,
- 4 cost for each regional material, and fraction by weight that is considered regional.
- 5 3. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.

- 6 C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- 7 D. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified
- 8 professional engineer responsible for their preparation.

- 9 1.5 INFORMATIONAL SUBMITTALS

- 10 A. Welding certificates.

- 11 B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop
- 12 primers are compatible with topcoats.

- 13 1.6 QUALITY ASSURANCE

- 14 A. Installer Qualifications: Fabricator of products.

- 15 B. Welding Qualifications: Qualify procedures and personnel according to the following:

- 16 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- 17 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

18 PART 2 - PRODUCTS

19 2.1 PERFORMANCE REQUIREMENTS

- 20 A. Delegated Design: Design metal stairs and railings, including comprehensive engineering analysis by a qualified
- 21 professional engineer, using performance requirements and design criteria indicated.

- 22 B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and
- 23 stresses within limits and under conditions indicated:

- 24 1. Uniform Load: 100 lbf/sq. ft. (4.79 kN/sq. m).
- 25 2. Concentrated Load: 300 lbf (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
- 26 3. Uniform and concentrated loads need not be assumed to act concurrently.
- 27 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified
- 28 above.
- 29 5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch (6.4 mm), whichever is less.

- 30 C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and
- 31 stresses within limits and under conditions indicated:

- 32 1. Handrails and Top Rails of Guards:

- 33 a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
- 34 b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
- 35 c. Uniform and concentrated loads need not be assumed to act concurrently.

- 1 2. Infill of Guards:
- 2 a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
- 3 b. Infill load and other loads need not be assumed to act concurrently.
- 4 D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according
- 5 to ASCE/SEI 7.
- 6 1. Component Importance Factor: 1.5.
- 7 2.2 METALS
- 8 A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components
- 9 exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or
- 10 blemishes.
- 11 B. Recycled Content of Steel Products: Provide products with average recycled content of steel products so
- 12 postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- 13 C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 14 D. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- 15 E. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel,
- 16 Grade 25 (Grade 170), unless another grade is required by design loads; exposed.
- 17 F. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel,
- 18 Grade 30 (Grade 205), unless another grade is required by design loads.
- 19 2.3 FASTENERS
- 20 A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M),
- 21 Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade,
- 22 and class required.
- 23 B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex
- 24 nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- 25 C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where
- 26 indicated, flat washers.
- 27 D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without
- 28 failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed
- 29 when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified
- 30 independent testing agency.
- 31 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or
- 32 ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
- 33 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel
- 34 bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).
- 35 2.4 MISCELLANEOUS MATERIALS
- 36 A. Shop Primers: Provide primers that comply with Division 09 Painting Sections.

1 B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2 2.5 FABRICATION, GENERAL

3 A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates,
4 and other components necessary to support and anchor stairs and platforms on supporting structure.

- 5 1. Join components by welding unless otherwise indicated.
6 2. Use connections that maintain structural value of joined pieces.

7 B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for
8 shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

9 C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32
10 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

11 D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

12 E. Form exposed work with accurate angles and surfaces and straight edges.

13 F. Weld connections to comply with the following:

- 14 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base
15 metals.
16 2. Obtain fusion without undercut or overlap.
17 3. Remove welding flux immediately.
18 4. Weld exposed corners and seams continuously unless otherwise indicated.
19 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards"
20 for Type 3 welds: partially dressed weld with spatter removed.

21 G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where
22 exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
23 Locate joints where least conspicuous.

24 2.6 STEEL-FRAMED STAIRS

25 A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in
26 NAAMM AMP 510, "Metal Stairs Manual," Commercial Class unless more stringent requirements are indicated.

27 B. Stair Framing:

- 28 1. Fabricate stringers of steel plates or channels as indicated on drawings.
29 a. Provide closures for exposed ends of channel stringers.
30 2. Construct platforms of steel plate or channels as indicated on drawings for headers and miscellaneous
31 framing members as needed to comply with performance requirements.
32 3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts,
33 fabricate and join so bolts are not exposed on finished surfaces.
34 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings
35 from floor construction above or below. Locate hanger rods and struts where they do not encroach on
36 required stair width and are within the fire-resistance-rated stair enclosure.
37 5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel
38 stair components before installing masonry.

1 C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of
2 thickness needed to comply with performance requirements, but not less than 0.067 inch (1.7 mm).

- 3 1. Steel Sheet: Uncoated hot-rolled steel sheet.
- 4 2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to
5 stringers and attach metal pans to brackets by welding, riveting, or bolting.
- 6 3. Shape metal pans to include nosing integral with riser.
- 7 4. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld
8 subplatforms to platform framing.

9 2.7 RAILINGS

10 A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish,
11 and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to
12 withstand indicated loads.

- 13 1. Handrails: 1-1/2-inch- (38-mm-) round rails.
- 14 2. Rails and Posts: 1-1/2-inch- (38-mm-) square top and bottom rails and 1-1/2-inch- (38-mm-) square posts.
- 15 3. Picket Infill: 1/2-inch- (13-mm-) square pickets spaced less than 4 inches (100 mm) clear.
- 16 4. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide
17 with spring hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from
18 opening in direction opposite egress.

19 B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close
20 fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

- 21 1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed
22 weld with spatter removed as shown in NAAMM AMP 521.

23 C. Form changes in direction of railings as follows:

- 24 1. By bending or by inserting prefabricated elbow fittings.

25 D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration
26 required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or
27 otherwise deforming exposed surfaces of components.

28 E. Close exposed ends of railing members with prefabricated end fittings.

29 F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless
30 clearance between end of rail and wall is 1/4 inch (6 mm) or less.

31 G. Connect posts to stair framing by direct welding unless otherwise indicated.

32 H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and
33 anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage
34 devices for connecting to concrete or masonry work.

35 I. For nongalvanized railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except
36 galvanize anchors embedded in exterior masonry and concrete construction.

- 37 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that
38 provides 1-1/2-inch (38-mm) clearance from inside face of handrail to finished wall surface
39

40 J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer
41 wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to
42 produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

1 2.8 FINISHES

2 A. Finish metal stairs after assembly.

3 B. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

4 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

5 2. Other Items: SSPC-SP 3, "Power Tool Cleaning."

6 PART 3 - EXECUTION

7 3.1 INSTALLING METAL PAN STAIRS

8 A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal
9 stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag
10 bolts, and other connectors.

11 B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units
12 accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

13 C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar
14 construction.

15 D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as
16 exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces
17 of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

18 E. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

19 F. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."

20 1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

21 G. Install precast concrete treads with adhesive supplied by manufacturer.

22 3.2 INSTALLING RAILINGS

23 A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing
24 indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends
25 to building construction as follows:

26 1. Anchor posts to steel by welding to steel supporting members.

27 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored
28 with postinstalled anchors and bolts.

29 B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to
30 support structural loads. Secure wall brackets to building construction as required to comply with performance
31 requirements.

32 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

33 2. For hollow masonry anchorage, use toggle bolts.

34 3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with
35 stud installation to locate backing members.

- 1 3.3 ADJUSTING AND CLEANING
- 2 A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop
- 3 paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching
- 4 up shop-painted surfaces.
- 5 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.
- 6 END OF SECTION 055113

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1 SECTION 061000 - ROUGH CARPENTRY

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Wood blocking and nailers.
9 2. Engineered wood products.
10 3. Plywood backing panels.

- 11 B. Related Requirements:

- 12 1. Section 061600 "Sheathing" for sheathing.

13 1.3 DEFINITIONS

- 14 A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

- 15 B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114
16 mm actual) size in least dimension.

- 17 C. Exposed Framing: Framing not concealed by other construction.

- 18 D. OSB: Oriented strand board.

19 1.4 ACTION SUBMITTALS

- 20 A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and
21 dimensions and include construction and application details.

- 22 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by
23 treating plant that treated materials comply with requirements. Indicate type of preservative used and net
24 amount of preservative retained.
25 2. For products receiving a waterborne treatment, include statement that moisture content of treated
26 materials was reduced to levels specified before shipment to Project site.

- 27 B. Sustainable Design Submittals:

- 28
29 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
30 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
31 product having recycled content.
32 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
33 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,

- 1 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
2 material, and fraction by weight that is considered regional.
3 3. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.

4 1.5 INFORMATIONAL SUBMITTALS

5 A. Evaluation Reports: For the following, from ICC-ES:

- 6 1. Wood-preserved-treated wood.
7 2. Engineered wood products.
8 3. Power-driven fasteners.

9 1.6 QUALITY ASSURANCE

- 10 A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material,
11 an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify
12 that the material bearing the classification marking is representative of the material tested.

13 1.7 DELIVERY, STORAGE, AND HANDLING

- 14 A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood
15 products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around
16 stacks and under coverings.

17 PART 2 - PRODUCTS

18 2.1 WOOD PRODUCTS, GENERAL

- 19 A. Maximum Moisture Content of Lumber: **19 percent** unless otherwise indicated.

- 20 B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code
21 research or evaluation reports exist that show compliance with building code in effect for Project.

- 22 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated.
23 Manufacturer's published values shall be determined from empirical data or by rational engineering analysis
24 and demonstrated by comprehensive testing performed by a qualified independent testing agency.

25 2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- 26 A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact
27 with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for
28 items in contact with ground.

- 29 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or
30 chromium.

- 31 B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped
32 or that does not comply with requirements for untreated material.

- 33 C. Application: Treat items indicated on Drawings, and the following:

- 1 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in
2 connection with roofing, flashing, vapor barriers, and waterproofing.
- 3 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.

4 2.3 ENGINEERED WOOD PRODUCTS

- 5 A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- 6 B. Laminated-Veneer Lumber: Structural composite lumber made from wood strand elements with grain primarily
7 parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an
8 exterior-type adhesive complying with ASTM D 2559.
9
- 10 1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi (20 MPa) for 12-inch nominal- (286-mm actual-) depth
11 members.
- 12 2. Modulus of Elasticity, Edgewise: 2,200,000 psi (15 100 MPa)

13 2.4 MISCELLANEOUS LUMBER

- 14 A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction,
15 including the following:
16 1. Blocking.
17 2. Nailers.
- 18 B. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may
19 be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- 20 C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and
21 other defects that will interfere with attachment of other work.
- 22 D. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing
23 bent-over nails and damage to paneling.

24 2.5 PLYWOOD BACKING PANELS

- 25 A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not
26 less than 3/4-inch (19-mm) nominal thickness.

27 2.6 FASTENERS

- 28 A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for
29 material and manufacture.
30 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area
31 of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- 32 B. Nails, Brads, and Staples: ASTM F 1667.
- 33 C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction,
34 based on ICC-ES AC70.

1 PART 3 - EXECUTION

2 3.1 INSTALLATION, GENERAL

3 A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough
4 carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with
5 requirements for attaching other construction.

6 B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing
7 panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed
8 to view.

9 C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and
10 trim.

11 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or
12 blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406
13 mm) o.c.

14 D. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the
15 following:

- 16 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
17 2. ICC-ES evaluation report for fastener.

18 3.2 WOOD BLOCKING, AND NAILER INSTALLATION

19 A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required
20 for true line and level of attached work. Coordinate locations with other work involved.

21 B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise
22 indicated.

23 3.3 PROTECTION

24 A. Protect rough carpentry from weather.

25 END OF SECTION 061000

1 SECTION 061600 - SHEATHING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Wall sheathing.
9 2. Sheathing joint and penetration treatment.

10 B. Related Requirements:

- 11 1. Section 061000 "Rough Carpentry" for plywood backing panels.

12 1.3 ACTION SUBMITTALS

- 13 A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and
14 dimensions and include construction and application details.

- 15 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by
16 treating plant that treated plywood complies with requirements. Indicate type of preservative used and net
17 amount of preservative retained.
18 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by
19 treating plant that treated plywood complies with requirements. Include physical properties of treated
20 materials.
21 3. For fire-retardant treatments, include physical properties of treated plywood both before and after
22 exposure to elevated temperatures, based on testing by a qualified independent testing agency according
23 to ASTM D 5516.
24 4. For products receiving waterborne treatment, include statement that moisture content of treated materials
25 was reduced to levels specified before shipment to Project site.

26 B. Sustainable Design Submittals:

- 27
28 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
29 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
30 product having recycled content.
31 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
32 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
33 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
34 material, and fraction by weight that is considered regional.
35 3. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.

1 1.4 INFORMATIONAL SUBMITTALS

2 A. Evaluation Reports: For the following, from ICC-ES:

- 3 1. Wood-preservative-treated plywood.
4 2. Fire-retardant-treated plywood.

5 1.5 QUALITY ASSURANCE

6 A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated
7 material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to
8 verify that the material bearing the classification marking is representative of the material tested.

9 1.6 DELIVERY, STORAGE, AND HANDLING

10 A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from
11 weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and
12 under coverings.

13 PART 2 - PRODUCTS

14 2.1 PERFORMANCE REQUIREMENTS

15 A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products
16 with appropriate markings of applicable testing agency.

- 17 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the
18 listings of another qualified testing agency.

19 2.2 WOOD PANEL PRODUCTS

20 A. Emissions: Products shall meet the testing and product requirements of the California Department of Public
21 Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor
22 Sources Using Environmental Chambers."

23 B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

24 C. Factory mark panels to indicate compliance with applicable standard.

25 2.3 PRESERVATIVE-TREATED PLYWOOD

26 A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact
27 with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for
28 items in contact with ground.

- 29 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or
30 chromium.

31 B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having
32 jurisdiction.

1 C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with
2 roofing, flashing, and waterproofing.

3 2.4 FIRE-RETARDANT-TREATED PLYWOOD

4 A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this
5 article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as
6 determined by testing identical products per test method indicated by a qualified testing agency.

7 B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested
8 according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an
9 additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of
10 the burners at any time during the test.

- 11 1. Use treatment that does not promote corrosion of metal fasteners.
- 12 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated
13 plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898.
14 Use for exterior locations and where indicated.
- 15 3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D 5516 and
16 design value adjustment factors shall be calculated according to ASTM D 6305. Span ratings after treatment
17 shall be not less than span ratings specified.

18 C. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped
19 or does not comply with requirements for untreated material.

20 D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

21 E. Application: Treat all plywood unless otherwise indicated.

22 2.5 WALL SHEATHING

23 A. Plywood Sheathing: DOC PS 1, Exterior, Structural I sheathing.

- 24 1. Span Rating: Not less than 32/16.
- 25 2. Nominal Thickness: Not less than 3/4 inch.

26 B. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

- 27 1. Type and Thickness: Regular, 1/2 inch (13 mm) thick.
- 28 2. Size: 48 by 96 inches (1219 by 2438 mm) for vertical installation.

30 2.6 FASTENERS

31 A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for
32 material and manufacture.

- 33 1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

34 B. Nails, Brads, and Staples: ASTM F 1667.

35 C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction,
36 based on ICC-ES AC70.

- 1 D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads
2 and reamer wings, length as recommended by screw manufacturer for material being fastened.
- 3 E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended
4 by sheathing manufacturer for thickness of sheathing to be attached.
5
- 6 1. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with
7 ASTM C 954.
- 8 F. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type
9 and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-
10 polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to
11 ASTM B 117. Provide washers or plates if recommended by sheathing manufacturer.

12 2.7 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

- 13 A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with
14 sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber
15 sheathing tape and for covering exposed fasteners.
- 16 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20
17 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape
18 manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and
19 with a history of successful in-service use.

20 PART 3 - EXECUTION

21 3.1 INSTALLATION, GENERAL

- 22 A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum
23 number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than
24 three support members.
- 25 B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless
26 otherwise indicated.
- 27 C. Securely attach to substrate by fastening as indicated, complying with the following:
- 28 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
29 2. ICC-ES evaluation report for fastener.
- 30 D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in
31 sequence and manner that prevent exterior moisture from passing through completed assembly.
- 32 E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support
33 elements.
- 34 F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed
35 to precipitation or left exposed at end of the workday when rain is forecast.

- 1 3.2 WOOD STRUCTURAL PANEL INSTALLATION
- 2 A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide,"
3 for types of structural-use panels and applications indicated.
- 4 B. Fastening Methods: Fasten panels as indicated below:
- 5 1. Wall Sheathing:
6 a. Screw to cold-formed metal framing.
7 b. Space panels **1/8 inch (3 mm)** apart at edges and ends.
- 8 3.3 GYPSUM SHEATHING INSTALLATION
- 9 A. Comply with GA-253 and with manufacturer's written instructions.
10
11 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
12 2. Install panels with a **3/8-inch (9.5-mm)** gap where non-load-bearing construction abuts structural elements.
13 3. Install panels with a **1/4-inch (6.4-mm)** gap where they abut masonry or similar materials that might retain
14 moisture, to prevent wicking.
- 15 B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- 16 C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels.
17 Attach at perimeter and within field of panel to each stud.
- 18 1. Space fasteners approximately **8 inches (200 mm)** o.c. and set back a minimum of **3/8 inch (9.5 mm)** from
19 edges and ends of panels.
- 20 D. Seal sheathing joints according to sheathing manufacturer's written instructions.
21
22 1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to
23 embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are
24 completely covered. Seal other penetrations and openings.
- 25 END OF SECTION 061600

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1 SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Plastic-laminate-faced architectural cabinets.

- 9 B. Related Requirements:

- 10 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for
11 installing cabinets that are concealed within other construction before cabinet installation.
12 2. Section 123623.13 "Plastic-Laminate-Clad Countertops."

13 1.3 COORDINATION

- 14 A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work
15 specified in other Sections to support loads imposed by installed and fully loaded cabinets.

16 1.4 PREINSTALLATION MEETINGS

- 17 A. Preinstallation Conference: Conduct conference at Project site.

18 1.5 ACTION SUBMITTALS

- 19 A. Product Data: For each type of product.

- 20 B. Sustainable Design Submittals:

- 21 1.
22 2. Product Data for Credit EQ 4.1: For installation adhesives, including printed statement of VOC content.
23 3. Product Data for Credit(s) MR 5: For products having recycled content, documentation indicating
24 percentages by weight of postconsumer and preconsumer recycled content.
25 a. Include statement indicating costs for each product having recycled content.
26 4. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
27 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
28 or recovery for each raw material.
29 a. Include statement indicating distance to Project, cost for each regional material, and fraction by
30 weight that is considered regional

- 31 C. Shop Drawings: For plastic-laminate-faced architectural cabinets.

- 32 1. Include plans, elevations, sections, and attachment details.

- 1 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and
2 reinforcement specified in other Sections.
- 3 3. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
- 4 D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or fabricator's
5 standard size.
- 6 E. Samples for Verification: For the following:
- 7 1. Plastic Laminates: **8 by 10 inches (200 by 250 mm)**, for each type, color, pattern, and surface finish required.
- 8 a. Provide one sample applied to core material with specified edge material applied to one edge.
- 9 2. Thermoset Decorative Panels: **8 by 10 inches (200 by 250 mm)**, for each color, pattern, and surface finish.
- 10 a. Provide edge banding on one edge.
- 11 3. Corner Pieces:
- 12 a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, **18 inches (450 mm)**
13 high by **18 inches (450 mm)** wide by **6 inches (150 mm)** deep.
- 14 b. Miter joints for standing trim.
- 15 4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.
- 16 1.6 INFORMATIONAL SUBMITTALS
- 17 A. Qualification Data: For fabricator.
- 18 B. Product Certificates: For the following:
- 19 1. Thermoset decorative panels.
- 20 2. High-pressure decorative laminate.
- 21 3. Adhesives.
- 22 1.7 QUALITY ASSURANCE
- 23 A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those
24 required for this Project and whose products have a record of successful in-service performance.
- 25 1.8 DELIVERY, STORAGE, AND HANDLING
- 26 A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have
27 been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions
28 comply with requirements specified in "Field Conditions" Article.
- 29 1.9 FIELD CONDITIONS
- 30 A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and
31 HVAC system is operating and maintaining temperature and relative humidity at levels planned for building
32 occupants during the remainder of the construction period.

1 B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other
2 construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate
3 fabrication schedule with construction progress to avoid delaying the Work.

4 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements
5 before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

6 PART 2 - PRODUCTS

7 2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

8 A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of
9 cabinets indicated for construction, finishes, installation, and other requirements.

10 1. The Contract Documents contain requirements that are more stringent than the referenced quality
11 standard. Comply with requirements of Contract Documents in addition to those of the referenced quality
12 standard.
13

14 B. Grade: Custom.

15 C. Type of Construction: Frameless.

16 D. Door and Drawer-Front Style: Flush overlay.

17 E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality
18 standard.
19

20 1. Basis of Design: Subject to compliance with requirements, provide product indicated on Drawings or
21 comparable product:

- 22 a. Abet Laminati, Inc.
- 23 b. Arborite; Division of ITW Canada, Inc.
- 24 c. Formica Corporation.
- 25 d. Lamin-Art, Inc.
- 26 e. Nevamar Company, LLC; Decorative Products Div.
- 27 f. Panolam Industries International Incorporated.
- 28 g. Westinghouse Electric Corp.; Specialty Products Div.
- 29 h. Wilsonart International; Div. of Premark International, Inc.

30 F. Laminate Cladding for Exposed Surfaces:

- 31 1. Horizontal Surfaces: Grade HGL.
- 32 2. Postformed Surfaces: Grade HGP.
- 33 3. Vertical Surfaces: Grade HGS.
- 34 4. Edges: Grade HGS
- 35 5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

36 G. Materials for Semiexposed Surfaces:

- 37 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - 38 a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching
39 laminate in color, pattern, and finish.
 - 40 b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-
41 pressure decorative laminate, NEMA LD 3, Grade VGS.

- 1 2. Drawer Sides and Backs: Solid-hardwood lumber.
- 2 3. Drawer Bottoms: Hardwood plywood.

- 3 H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3,
4 Grade BKL.

- 5 I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of
6 body.
- 7 1. Join subfronts, backs, and sides with glued dovetail joints.

- 8 J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate
9 surfaces complying with the following requirements:
- 10 1. PL-1.
- 11 a. Pionite WW-110 SD Kingsley.

- 12 2.2 WOOD MATERIALS

- 13 A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of
14 architectural cabinet and quality grade specified unless otherwise indicated.
- 15 1. Wood Moisture Content: 5 to 10 percent.

- 16 B. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled
17 content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25
18 percent.

- 19 C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality
20 standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
- 21 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
- 22 2. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
- 23 3. Softwood Plywood: DOC PS 1.
- 24 4. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated
25 decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4,
26 3.6, 3.8, and 3.10.

- 27 2.3 CABINET HARDWARE AND ACCESSORIES

- 28 A. Butt Hinges: 2-3/4-inch (70-mm), five-knuckle steel hinges made from 0.095-inch- (2.4-mm-) thick metal, and as
29 follows:
- 30 1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.

- 31 B. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.

- 32 C. Catches: Magnetic catches, BHMA A156.9, B03141.

- 33 D. Shelf Rests: BHMA A156.9, B04013; metal.

- 34 E. Drawer Slides: BHMA A156.9.
- 35 1. Grade 1 and Grade 2: Side mounted.

- 1 a. Type: Full extension.
2 b. Material: Zinc-plated steel with polymer rollers.
- 3 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
4 3. For drawers but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide,
5 provide Grade 1.
6 4. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide Grade 1HD-
7 100.
8 5. For trash bins provide Grade 1HD-200.
- 9 F. Door Locks: BHMA A156.11, E07121.
- 10 G. Drawer Locks: BHMA A156.11, E07041.
- 11 H. Door and Drawer Silencers: BHMA A156.16, L03011.
- 12 I. Grommets for Cable Passage: 2-inch (51-mm) OD, molded-plastic grommets and matching plastic caps with slot for
13 wire passage.
- 14 1. Color: Black.
- 15 J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA
16 finish number indicated.
- 17 1. Satin Stainless Steel: BHMA 630.
- 18 K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in
19 BHMA A156.9.
- 20 2.4 MISCELLANEOUS MATERIALS
- 21 A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent
22 moisture content.
- 23 B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal
24 expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized
25 anchors and inserts at inside face of exterior walls and at floors.
- 26 C. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for
27 VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
28
- 29 1. Wood Glues: 30 g/L.
30 2. Contact Adhesive: 250 g/L.
- 31 D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement or Contact cement.
- 32 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- 33 2.5 FABRICATION
- 34 A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- 35 B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment
36 to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for
37 fitting at site, provide ample allowance for scribing, trimming, and fitting.

1 PART 3 - EXECUTION

2 3.1 PREPARATION

3 A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

4 3.2 INSTALLATION

5 A. Grade: Install cabinets to comply with quality standard grade of item to be installed.

6 B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

7 C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet
8 installation screws.

9 D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm) using
10 concealed shims.

11 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

12 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust
13 hardware to center doors and drawers in openings and to provide unencumbered operation. Complete
14 installation of hardware and accessory items as indicated.

15 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c.
16 with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing,
17 blocking, or hanging strips.

18 3.3 ADJUSTING AND CLEANING

19 A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not
20 possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

21 B. Clean, lubricate, and adjust hardware.

22 C. Clean cabinets on exposed and semiexposed surfaces.

23 END OF SECTION 064116

1 SECTION 064600 - WOOD TRIM

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Interior standing and running trim.
9 2. Shop finishing of wood trim.

10 B. Related Requirements:

- 11 1. Section 061000 "Rough Carpentry" for wood furring, blocking, and shims required for installing wood trim
12 and concealed within other construction before wood trim installation.

13 1.3 ACTION SUBMITTALS

14 A. Product Data: For each type of product, **including finishing materials and processes.**

- 15 1. VOC content.
16

17 B. Sustainable Design Submittals:

18 C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment
19 devices, and other components.

20 D. Samples for Initial Selection:

- 21 1. Shop-applied transparent finishes.

22 E. Samples for Verification:

- 23 1. Lumber for transparent finish, not less than **12 inches (300 mm) long**] for each species and cut, finished on
24 one side and one edge.

25 F. LEED Submittals:

- 26
27 1. Product Data for Credit EQ 4.2: For interior stains and coatings, documentation including printed statement
28 of VOC content
29 2. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply
30 with requirements for regional materials, certificates indicating location of material manufacturer and point
31 of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project,
32 cost for each regional material, and fraction by weight that is considered regional.

1 1.4 INFORMATIONAL SUBMITTALS

- 2 A. Product Certificates: For **the following**:
3 1. Adhesives.

4 1.5 QUALITY ASSURANCE

- 5 A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those
6 required for this Project and whose products have a record of successful in-service performance.

7 1.6 DELIVERY, STORAGE, AND HANDLING

- 8 A. Do not deliver wood trim until operations that could damage wood trim have been completed in installation areas.
9 If wood trim must be stored in other than installation areas, store only in areas where environmental conditions
10 comply with requirements specified in "Field Conditions" Article.

11 1.7 FIELD CONDITIONS

- 12 A. Weather Limitations for Exterior Work: Proceed with installation of exterior wood trim only when existing and
13 forecasted weather conditions permit work to be performed and at least one coat of specified finish to be applied
14 without exposure to rain, snow, or dampness.

- 15 B. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until building is enclosed,
16 wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at
17 occupancy levels during the remainder of the construction period.

- 18 C. Environmental Limitations for Interior Work: Do not deliver or install interior wood trim until building is enclosed,
19 wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16
20 and 32 deg C) and relative humidity between 25 and 55 percent during the remainder of the construction period.

21 1.8 COORDINATION

- 22 A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work
23 specified in other Sections to ensure that wood trim can be supported and installed as indicated.

24 PART 2 - PRODUCTS

25 2.1 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

- 26 A. Grade: Premium, with Grade A faces.

- 27 B. Wood Species and Cut:

- 28 1. Species: Select White Birch.
29 2. Cut: **Plain sliced/plain sawn.**

- 1 2.2 WOOD MATERIALS
- 2 A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of
3 wood trim and quality grade specified unless otherwise indicated.
4
- 5 1. Wood Moisture Content for Interior Materials: **5 to 10** percent.
- 6 2.3 MISCELLANEOUS MATERIALS
- 7 A. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- 8 B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal
9 expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized
10 anchors and inserts at inside face of exterior walls and at floors.
- 11 2.4 FABRICATION
- 12 A. Fabricate wood trim to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
- 13 1. Edges of Solid-Wood (Lumber) Members: **1/16 inch (1.5 mm)** unless otherwise indicated.
14 2. Edges of Rails and Similar Members More Than **3/4 Inch (19 mm)** Thick: **1/8 inch (3 mm)**.
- 15 B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members except for members with
16 ends exposed in finished work.
- 17 2.5 SHOP FINISHING
- 18 A. General: Finish wood trim at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and
19 polishing until after installation.
- 20 B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and
21 finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated
22 according to 40 CFR 59, Subpart D (EPA Method 24).
23
- 24 1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
25 2. Shellacs, Clear: VOC not more than 730 g/L.
26 3. Stains: VOC not more than 250 g/L.
27 4.
28 5. Primers, Sealers, and Undercoaters: 200 g/L.
- 29 C. Low-Emitting Materials: Interior stains and finishes shall comply with the testing and product requirements of the
30 California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from
31 Various Sources Using Small-Scale Environmental Chambers."
- 32 D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners,
33 sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.
- 34 1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of
35 wood trim. Apply two coats to end-grain surfaces.
- 36 E. Transparent Finish for Interior Trim:
- 37 1. Grade: **Premium**.
38 2. Finish: System - 11, catalyzed polyurethane.

- 1 3. Staining: **Match Architect's sample.**
- 2 4. Sheen: **Satin, 31-45** gloss units measured on 60-degree gloss meter per ASTM D 523.

3 PART 3 - EXECUTION

4 3.1 PREPARATION

- 5 A. Before installation, condition wood trim to average prevailing humidity conditions in installation areas.
- 6 B. Before installing architectural wood trim, examine shop-fabricated work for completion and complete work as
- 7 required, including removal of packing and backpriming.

8 3.2 INSTALLATION

- 9 A. Grade: Install wood trim to comply with same grade as item to be installed.
- 10 B. Assemble wood trim and complete fabrication at Project site to the extent that it was not completed in the shop.
- 11 C. Install wood trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to
- 12 a tolerance of **1/8 inch in 96 inches (3 mm in 2400 mm)**.
- 13 D. Scribe and cut wood trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- 14 E. Anchor wood trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk,
- 15 concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush
- 16 with woodwork.
- 17 1. For shop-finished items, use filler matching finish of items being installed.
- 18 F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum
- 19 length of lumber available) to greatest extent possible. Do not use pieces less than **96 inches** long except where
- 20 shorter single-length pieces are necessary.
- 21 1. Install standing and running trim with no more variation from a straight line than **1/8 inch in 96 inches (3**
- 22 **mm in 2400 mm)**.
- 23
- 24 G. Touch up finishing work specified in this Section after installation of wood trim. Fill nail holes with matching filler
- 25 where exposed.
- 26 1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only
- 27 sealer/prime coats are applied in shop.

28 3.3 ADJUSTING AND CLEANING

- 29 A. Repair damaged and defective wood trim, where possible, to eliminate functional and visual defects; where not
- 30 possible to repair, replace wood trim. Adjust joinery for uniform appearance.
- 31 B. Clean wood trim on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or
- 32 soiled areas.

33 END OF SECTION 064600

1 SECTION 071413 - HOT FLUID-APPLIED RUBBERIZED ASPHALT WATERPROOFING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Rubberized-asphalt waterproofing membrane, reinforced.
9 2. Molded-sheet drainage panels.
10 3. Insulation.

11 1.3 ACTION SUBMITTALS

- 12 A. Product Data: For each type of product. Include manufacturer's written instructions for evaluating, preparing, and
13 treating substrate, technical data, and tested physical and performance properties of waterproofing.

- 14 B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet
15 flashings, penetrations, inside and outside corners, tie-ins to adjoining waterproofing, and other termination
16 conditions.

17 1.4 INFORMATIONAL SUBMITTALS

- 18 A. Qualification Data: For Installer.

- 19 B. Sample Warranties: For special warranties.

20 1.5 QUALITY ASSURANCE

- 21 A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

- 22 B. Source Limitations: Obtain waterproofing materials sheet flashings molded-sheet drainage panels insulation from
23 single source from single manufacturer.

24 1.6 DELIVERY, STORAGE, AND HANDLING

- 25 A. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the
26 temperature range required by waterproofing manufacturer.

- 27 B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

- 28 C. Protect stored materials from direct sunlight.

1 1.7 FIELD CONDITIONS

2 A. Weather Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended
3 by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, or when temperature is
4 below zero deg F (minus 18 deg C).

5 1. Do not apply waterproofing in snow, rain, fog, or mist.

6 B. Maintain adequate ventilation during application and curing of waterproofing materials.

7 1.8 WARRANTY

8 A. Special Warranty: Manufacturer agrees to repair or replace waterproofing and sheet flashings that do not comply
9 with requirements or that fail to remain watertight within specified warranty period.

10 1. Warranty includes removing and reinstalling protection board, drainage panels, and insulation.

11 2. Warranty insulation retains 80 percent of original published thermal value.

12 3. Warranty Period: 10 years from date of Substantial Completion.

13 PART 2 - PRODUCTS

14 2.1 WATERPROOFING MEMBRANE

15 A. Hot Fluid-Applied, Rubberized-Asphalt Waterproofing Membrane: Single component; 100 percent solids; hot fluid-
16 applied, rubberized asphalt.

17 2.2 MANUFACTURERS

18 A. Products: Subject to compliance with requirements, provide one of the following:

19 1. American Hydrotech, Inc.; Monolithic Membrane 6125.

20 2. Carlisle Coatings & Waterproofing Inc.; CCW-500R.

21 3. Tremco Incorporated; Tremproof 150.

22 2.3 AUXILIARY MATERIALS

23 A. General: Auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with
24 waterproofing.

25 B. Primer: ASTM D 41/D 41M, asphaltic primer.

26 C. Elastomeric Sheet: 50-mil- (1.3-mm-) minimum, uncured sheet neoprene as follows:

27 1. Tensile Strength: 1400 psi (9.6 MPa) minimum; ASTM D 412, Die C.

28 2. Elongation: 300 percent minimum; ASTM D 412.

29 3. Tear Resistance: 125 psi (860 kPa) minimum; ASTM D 624, Die C.

30 4. Brittleness: Does not break at minus 30 deg F (34 deg C); ASTM D 2137.

31 D. Sealants and Accessories: Manufacturer's recommended sealants and accessories.

32 E. Reinforcing Fabric: Manufacturer's recommended, spun-bonded polyester fabric.

1 F. Protection Course: Manufacturer's standard, 80- to 90-mil- (2.0- to 2.3-mm-) thick, fiberglass-reinforced rubberized
2 asphalt or modified bituminous sheet.

3 2.4 MOLDED-SHEET DRAINAGE PANELS

4 A. Woven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels
5 consisting of a woven-geotextile facing with an apparent opening size not exceeding No. 40 (0.43-mm) sieve,
6 laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-
7 plastic-sheet drainage core, with a horizontal flow rate not less than 2.8 gpm/ft. (35 L/min. per m).

8 2.5 INSULATION

9 A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, Type IV, 25-psi (173-kPa)
10 minimum compressive resistance, shiplap edged.

11 B. Thickness: 2-inches

12 PART 3 - EXECUTION

13 3.1 EXAMINATION

14 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
15 tolerances and other conditions affecting performance of the Work.

- 16 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing
17 manufacturer.
18 2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method
19 according to ASTM D 4263.

20 B. Proceed with installation only after unsatisfactory conditions have been corrected.

21 3.2 PREPARATION

22 A. Clean and prepare substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry
23 substrate for waterproofing application.

24 B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other
25 construction.

26 C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

27 D. Remove grease, oil, form-release agents, paints, curing compounds, and other penetrating contaminants or film-
28 forming coatings from concrete.

- 29 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to
30 ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a
31 sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release
32 agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

33 E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, and other voids.

1 3.3 JOINTS, CRACKS, AND TERMINATIONS

- 2 A. Prepare and treat substrates to receive waterproofing membrane, including joints and cracks, deck drains, corners,
3 and penetrations according to manufacturer's written instructions.
- 4 1. Rout and fill joints and cracks in substrate. Before filling, remove dust and dirt according to ASTM D 4258.
5 2. Adhere strip of elastomeric sheet to substrate in a layer of hot rubberized asphalt. Extend elastomeric sheet
6 a minimum of 6 inches (150 mm) on each side of moving joints and cracks or joints and cracks exceeding 1/8
7 inch (3 mm) thick, and beyond deck drains and penetrations. Apply second layer of hot fluid-applied,
8 rubberized asphalt over elastomeric sheet.
9 3. Embed strip of reinforcing fabric into a layer of hot rubberized asphalt. Extend reinforcing fabric a minimum
10 of 6 inches (150 mm) on each side of nonmoving joints and cracks not exceeding 1/8 inch (3 mm) thick, and
11 beyond roof drains and penetrations.

12 3.4 FLASHING INSTALLATION

- 13 A. Install elastomeric sheets at terminations of waterproofing membrane according to manufacturer's written
14 instructions.
- 15 B. Prime substrate with asphalt primer.
- 16 C. Install elastomeric sheet and adhere to deck and wall substrates in a layer of hot rubberized asphalt.

17 3.5 MEMBRANE APPLICATION

- 18 A. Apply primer, at manufacturer's recommended rate, over prepared substrate and allow it to dry.
- 19 B. Heat and apply rubberized asphalt according to manufacturer's written instructions.
- 20 1. Heat rubberized asphalt in an oil- or air-jacketed melter with mechanical agitator specifically designed for
21 heating rubberized asphalt.
- 22 C. Start application with manufacturer's authorized representative present.
- 23 D. Reinforced Membrane: Apply hot rubberized asphalt to substrates and adjoining surfaces indicated. Spread to a
24 thickness of 90 mils (2.3 mm); embed reinforcing fabric, overlapping sheets 2 inches (50 mm); spread another 125-
25 mil- (3.2-mm-) thick layer to provide a uniform, reinforced, seamless membrane 215 mils (5.5 mm) thick.
- 26 E. Apply waterproofing over prepared joints and up wall terminations and vertical surfaces to heights indicated or
27 required by manufacturer.
- 28 F. Cover waterproofing with protection course with overlapped joints before membrane is subject to backfilling.

29 3.6 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

- 30 A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate according
31 to manufacturer's written instructions. Use methods that do not penetrate waterproofing. Lap edges and ends of
32 geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
- 33 1. For vertical applications, install board insulation before installing drainage panels.

- 1 3.7 INSULATION INSTALLATION
- 2 A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit
3 to within 3/4 inch (19 mm) of projections and penetrations.
- 4 B. On vertical surfaces, set insulation units into rubberized asphalt according to manufacturer's written instructions.
- 5 3.8 CLEANING AND PROTECTION
- 6 A. Protect waterproofing from damage and wear during remainder of construction period.
- 7 B. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and
8 other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and
9 protected by permanent construction immediately after installation.
- 10 C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by
11 manufacturer of affected construction.
- 12 END OF SECTION 071413

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1 SECTION 071800 - TRAFFIC COATINGS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes traffic coatings and pavement markings for the following applications:

- 8 1. Vehicular traffic.

9 1.3 PREINSTALLATION MEETINGS

- 10 A. Preinstallation Conference: Conduct conference at Project site.

11 1.4 ACTION SUBMITTALS

- 12 A. Product Data: For each type of product.

- 13 1. Include installation instructions and details, material descriptions, dry or wet film thickness requirements,
14 and finish.

- 15 B. Sustainable Design Submittals:

- 16 1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
17 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
18 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
19 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
20 material, and fraction by weight that is considered regional.

- 21 C. Shop Drawings: For traffic coatings.

- 22 1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination
23 conditions that are not included in manufacturer's product data.

- 24 2. Include plans showing layout of pavement markings, lane separations, and defined parking spaces. Indicate,
25 with international symbol of accessibility, spaces allocated for people with disabilities.

- 26 D. Samples for Initial Selection: For each type of exposed finish.

27 1.5 INFORMATIONAL SUBMITTALS

- 28 A. Qualification Data: For Installer.

- 29 B. Product Certificates: For each type of traffic coating.

- 1 C. Field quality-control reports.
- 2 D. Sample Warranty: For manufacturer's warranty.
- 3 1.6 CLOSEOUT SUBMITTALS
- 4 A. Maintenance Data: For traffic coatings to include in maintenance manuals.
- 5 1.7 QUALITY ASSURANCE
- 6 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
7 manufacturer.
- 8 B. Mockups: Build mockups to set quality standards for materials and execution.
- 9 1. Build mockup for each traffic coating and substrate to receive traffic coatings.
- 10 2. Size: 200 sq. ft. (18.5 sq. m) of each substrate to demonstrate surface preparation, joint and crack
11 treatment, thickness, texture, color, and standard of workmanship.
- 12 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
13 mockups unless Architect specifically approves such deviations in writing.
- 14 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
15 undisturbed at time of Substantial Completion.
- 16 1.8 FIELD CONDITIONS
- 17 A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures
18 recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when
19 temperatures are below 40 deg F (5 deg C), when relative humidity exceeds 85 percent, or when temperatures are
20 less than 5 deg F (3 deg C) above dew point.
- 21 1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent
22 during the application and curing period. Apply only when frost-free conditions occur throughout the depth
23 of substrate.
- 24 B. Do not install traffic coating until items that penetrate membrane have been installed.
- 25 C. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or
26 surface temperature of 50 deg F (10 deg C) for water-based materials, and not exceeding 95 deg F (35 deg C).
- 27 1.9 WARRANTY
- 28 A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or
29 workmanship within specified warranty period.
- 30 1. Failures include, but are not limited to, the following:
- 31 a. Adhesive or cohesive failures.
- 32 b. Abrasion or tearing failures.
- 33 c. Surface crazing or spalling.
- 34 d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
- 35 2. Warranty Period: Five years from date of Substantial Completion.

1 PART 2 - PRODUCTS

2 2.1 MANUFACTURERS

3 A. Source Limitations:

- 4 1. Obtain traffic coatings from single source from single manufacturer.
- 5 2. Obtain pavement-marking paint from single source from single manufacturer.

6 2.2 PERFORMANCE REQUIREMENTS

7 A. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that
8 are compatible with one another and with substrate under conditions of service and application, as demonstrated
9 by manufacturer based on testing and field experience.

10 2.3 TRAFFIC COATING TC-1

11 A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied,
12 elastomeric, water-resistant membrane system with integral wearing surface for vehicular traffic; according to
13 ASTM C 957/C 957M.

14 1. Basis of Design Products: Tremco, Inc.; Vulkem 350NF/950NF/950NF

15 B. Primer: Liquid primer as recommended in writing for substrate and conditions by traffic-coating manufacturer.

16 1. Material: Polyurethane.

17 C. Preparatory and Base Coats: Aromatic Polyurethane.

18 1. Thicknesses: Minimum 25 wet mils film thickness as recommended in writing by manufacturer for substrate
19 and service conditions indicated.

20 D. Intermediate Coat: Aromatic Polyurethane.

21 1. Thicknesses: Minimum 12 wet mils film thickness as recommended in writing by manufacturer for substrate
22 and service conditions indicated, measured excluding aggregate.

23 2. Aggregate Content: To refusal.

24 E. Topcoat: Aromatic Polyurethane.

25 1. Thicknesses: Minimum 12 wet mils film thickness as recommended in writing by manufacturer for substrate
26 and service conditions indicated, measured excluding aggregate.

27 2. Color: As selected by Architect from manufacturer's full range.

28 F. Aggregate: Uniformly graded, washed silica sand of particle sizes, shape, and minimum hardness recommended in
29 writing by traffic-coating manufacturer.

30 2.4 ACCESSORY MATERIALS

31 A. Joint Sealants: ASTM C 920, type NS, Class 50.

32 B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.

- 1 1. Thickness: Minimum 50 mils (1.3 mm).
- 2 C. Adhesive: Contact adhesive recommended in writing by traffic-coating manufacturer.
- 3 D. Reinforcing Strip: Fiberglass mesh recommended in writing by traffic-coating manufacturer.
- 4 2.5 PAVEMENT MARKINGS
- 5 A. Pavement-Marking Paint: Comply with the following:
- 6 B. Pavement-Marking Paint: 100% acrylic, lead free yellow, low VOC, conventional dry (non-heat applied) acetone
7 based paint complying with TT-P-115-F, with drying time of less than 45 minutes.
- 8 1. Product: Sherwin Williams; Promar low VOC acrylic copolymer traffic marking paint.
9 2. Color: Yellow.

10 PART 3 - EXECUTION

11 3.1 EXAMINATION

- 12 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum
13 moisture content, surface smoothness, and other conditions affecting performance of traffic-coating work.
- 14 B. Verify that substrates are visibly dry and free of moisture.
15 1. Test for moisture content by method recommended in writing by traffic-coating manufacturer.
- 16 C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.
- 17 D. Proceed with installation only after unsatisfactory conditions have been corrected.
- 18 1. Begin coating application only after substrate construction and penetrating work have been completed.
19 2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing
20 by traffic-coating manufacturer has passed and after substrates are dry.
21 3. Application of coating indicates acceptance of surfaces and conditions.

22 3.2 PREPARATION

- 23 A. Clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean,
24 dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as
25 recommended in writing by traffic-coating manufacturer.
- 26 B. Priming: Unless manufacturer recommends in writing against priming, prime substrates according to
27 manufacturer's written instructions.
- 28 1. Limit priming to areas that will be covered by traffic-coating material on same day. Reprime areas exposed
29 for more time than recommended by manufacturer.
- 30 C. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.
- 31 D. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of
32 coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and
33 drains.

- 1 E. Concrete Substrates: Mechanically abrade surface to a uniform profile acceptable to manufacturer, according to
2 ASTM D 4259. Do not acid etch.
- 3 1. Remove grease, oil, paints, and other penetrating contaminants from concrete.
4 2. Remove concrete fins, ridges, and other projections.
5 3. Remove laitance, glaze, efflorescence, curing compounds, concrete hardeners, form-release agents, and
6 other incompatible materials that might affect coating adhesion.
7 4. Remove remaining loose material to provide a sound surface, and clean surfaces according to ASTM D 4258.
- 8 3.3 TERMINATIONS AND PENETRATIONS
- 9 A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion
10 joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.
- 11 B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.
- 12 C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.
- 13 D. Install sheet flashings at deck-to-wall expansion and dynamic joints, and bond to deck and wall substrates according
14 to manufacturer's written recommendations.
- 15 3.4 JOINT AND CRACK TREATMENT
- 16 A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written
17 recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.
- 18 1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.
- 19 B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.
- 20 3.5 TRAFFIC-COATING APPLICATION
- 21 A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.
- 22 B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.
- 23 C. Start traffic-coating application in presence of manufacturer's technical representative.
- 24 D. Verify that wet-film thickness of each coat complies with requirements every 100 sq. ft. (9 sq. m).
- 25 E. Uniformly broadcast and embed aggregate in each coat indicated to receive aggregate according to manufacturer's
26 written instructions. After coat dries, sweep away excess aggregate.
- 27 F. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on
28 vertical surfaces.
- 29 G. Cure traffic coatings. Prevent contamination and damage during coating application and curing.
- 30 3.6 PAVEMENT MARKINGS
- 31 A. Do not apply pavement-marking paint for striping and other markings until layout, colors, and placement have been
32 verified with Architect and traffic coating has cured.

- 1 B. Sweep and clean surface to eliminate loose material and dust.
- 2 C. Apply pavement-marking paint with mechanical equipment to produce markings of dimensions indicated with
- 3 uniform straight edges. Apply at manufacturer's recommended rates for a minimum wet-film thickness of 15-mils
- 4 (0.4-mm).

5 3.7 FIELD QUALITY CONTROL

- 6 A. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect
- 7 membrane installation on completion.

- 8 1. Notify Owner 48 hours in advance of date and time of inspection.

- 9 B. Waterproofing will be considered defective if it does not pass tests and inspections.

- 10 C. Prepare test and inspection reports.

11 3.8 PROTECTING AND CLEANING

- 12 A. Protect traffic coatings from damage and wear during remainder of construction period.

- 13 B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by
- 14 manufacturer of affected construction.

15 END OF SECTION 071800

1 SECTION 072100 - THERMAL INSULATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Extruded polystyrene foam-plastic board.
9 2. Glass-fiber blanket insulation.
10 3. Mineral-wool blanket.

11 B. Related Requirements:

- 12 1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
13 2. **Section 071413 "Hot Fluid-Applied Rubberized Asphalt Waterproofing"** for insulation panels installed as
14 part of the waterproofing system.
15 3. Section 072119 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
16 4. **Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing"** for insulation specified as part of
17 roofing construction.
18 5. **Section 092900 "Gypsum Board"** for sound attenuation blanket used as acoustic insulation.

19 1.3 ACTION SUBMITTALS

- 20 A. Product Data: For each type of product.

21 B. Sustainable Design Submittals:

- 22 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
23 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
24 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
25 material, and fraction by weight that is considered regional.
26 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
27 by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each
28 product having recycled content.

29 1.4 INFORMATIONAL SUBMITTALS

- 30 A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- 31 B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

- 1 1.5 DELIVERY, STORAGE, AND HANDLING
- 2 A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other
3 sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing,
4 and protecting during installation.
- 5 B. Protect foam-plastic board insulation as follows:
- 6 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
7 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just
8 before installation time.
9 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of
10 construction.

11 PART 2 - PRODUCTS

12 2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- 13 A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578
14 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other
15 characteristics.
- 16 B. Extruded Polystyrene Board, Type IV: ASTM C 578, Type IV, 25-psi (104-kPa) minimum compressive strength;
17 unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
18
19 1. Thickness: 3-inches.
20 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- 21 C. Sustainability Requirements: Provide rigid insulation as follows:
22
23 1. Recycled Content of rigid insulation Products: Preconsumer recycled content not less than 20 percent.

24 2.2 GLASS-FIBER BLANKET INSULATION

- 25 A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be
26 incorporated into the Work include, but are not limited to, the following:
27
28 1. CertainTeed Corporation.
29 2. Guardian Building Products, Inc.
30 3. Johns Manville.
31 4. Knauf Insulation.
32 5. Owens Corning.
- 33 B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed
34 indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
35
36 1. R-Value: R-13.
- 37 C. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
38
39 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
40 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm
41 formaldehyde.

1 3. Recycled Content of rigid insulation Products: Postconsumer recycled content plus one-half of preconsumer
2 recycled content not less than 30 percent.

3 2.3 MINERAL-WOOL BLANKETS

4 A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with
5 maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing
6 ASTM E 136 for combustion characteristics.

7 B. Sustainability Requirements: Provide mineral -wool insulation as follows:

8
9 1. Recycled Content of mineral-wool insulation Products: Preconsumer recycled content not less than 75
10 percent.

11 2.4 INSULATION FASTENERS

12 A. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without
13 damaging insulation, fasteners, or substrates.

14 2.5 ACCESSORIES

15 A. Insulation for Miscellaneous Voids:

16 1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and
17 smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

18 PART 3 - EXECUTION

19 3.1 PREPARATION

20 A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing
21 insulation or vapor retarders, or that interfere with insulation attachment.

22 3.2 INSTALLATION, GENERAL

23 A. Comply with insulation manufacturer's written instructions applicable to products and applications.

24 B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at
25 any time.

26 C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation.
27 Remove projections that interfere with placement.

28 D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply
29 single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or
30 to achieve R-value.

- 1 3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION
- 2 A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no
3 specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide
4 permanent placement and support of units.
- 5 B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the
6 following requirements:
7
- 8 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length
9 is required to fill the cavities, provide lengths that will produce a snug fit between ends.
- 10 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation
11 and adjoining framing members.
- 12 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected
13 from contact with insulation.
- 14 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets
15 mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- 16 3.4 INSTALLATION OF CAVITY-WALL INSULATION
- 17 A. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each
18 unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or
19 sealant as recommended by insulation manufacturer.
20
- 21 1. Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as
22 recommended by manufacturer. Fit courses of insulation between ties and other obstructions, with edges
23 butted tightly in both directions. Press units firmly against inside substrates.
- 24 3.5 PROTECTION
- 25 A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
26 Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and
27 protected by permanent construction immediately after installation.
- 28 END OF SECTION 072100

1 SECTION 072119 - FOAMED-IN-PLACE INSULATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Closed-cell spray polyurethane foam (SPF).
9 2. Open-cell spray polyurethane foam (SPF).
10 3. Thermal Barrier.

- 11 B. Related Requirements:

- 12 1. Section 072100 "Thermal Insulation" for foam-plastic board insulation.

13 1.3 ACTION SUBMITTALS

- 14 A. Product Data: For each type of product.

- 15 B. Sustainable Design Submittals:

- 16
17 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
18 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
19 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
20 material, and fraction by weight that is considered regional.
21 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
22 by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each
23 product having recycled content.

24 1.4 INFORMATIONAL SUBMITTALS

- 25 A. Qualification Data: For Installer.

- 26 B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

- 27 C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

28 1.5 QUALITY ASSURANCE

- 29 A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1 PART 2 - PRODUCTS

2 2.1 OPEN-CELL SPRAY POLYURETHANE FOAM

3 A. Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum
4 density of **0.4 lb/cu. ft. (6.4 kg/cu. m)** and minimum aged R-value at **1-inch (25.4-mm)** thickness of **3.4 deg F x h x sq.**
5 **ft./Btu at 75 deg F (24 K x sq. m/W at 24 deg C).**
6

7 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify
8 products with appropriate markings of applicable testing agency.

- 9 a. Flame-Spread Index: 25 or less.
10 b. Smoke-Developed Index: 450 or less.

11 2.2 CLOSED-CELL SPRAY POLYURETHANE FOAM

12 A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of **1.5 lb/cu. ft.** and minimum aged
13 R-value at **1-inch (25.4-mm)** thickness of **6.2 deg F x h x sq. ft./Btu at 75 deg F (43 K x sq. m/W at 24 deg C).**
14

15 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify
16 products with appropriate markings of applicable testing agency.

- 17 a. Flame-Spread Index: **25** or less.
18 b. Smoke-Developed Index: **450** or less.

19 2.3 MISCELLANEOUS MATERIALS

20 A. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

21 B. Thermal Barrier.

22 1. NFPA 275 compliant.
23

24 PART 3 - EXECUTION

25 3.1 PREPARATION

26 A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

27 B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation
28 manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration
29 onto adjoining surfaces.

30 3.2 INSTALLATION

31 A. Comply with insulation manufacturer's written instructions applicable to products and applications.

32 B. Spray insulation to envelop entire area to be insulated and fill voids.

- 1 C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into
- 2 rising foam.

- 3 D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.

- 4 E. Miscellaneous Voids: Apply according to manufacturer's written instructions.

- 5 F. Separate interior building spaces from SPF by an approved thermal barrier.

- 6 3.3 PROTECTION

- 7 A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

- 8 END OF SECTION 072119

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1 SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

8 1. Vapor-retarding, fluid-applied air barriers.

- 9 B. Related Requirements:

10 1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

11 1.3 DEFINITIONS

12 A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

13 B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

14 C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including
15 joints and junctions to abutting construction, to control air movement through the wall.

16 1.4 PREINSTALLATION MEETINGS

- 17 A. Preinstallation Conference: Conduct conference at Project site.

18 1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-
19 barrier protection, and work scheduling that covers air barriers.

20 1.5 ACTION SUBMITTALS

- 21 A. Product Data: For each type of product.

22 1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical
23 data; dry film thickness; and tested physical and performance properties of products.

- 24 B. Shop Drawings: For air-barrier assemblies.

25 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project
26 conditions.

27 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside
28 corners, terminations, and tie-ins with adjoining construction.

29 3. Include details of interfaces with other materials that form part of air barrier.

- 1 1.6 INFORMATIONAL SUBMITTALS
- 2 A. Qualification Data: For Installer.
- 3 B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials
4 with Project materials that connect to or that come in contact with the barrier.
- 5 C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.
- 6 D. Field quality-control reports.
- 7 1.7 QUALITY ASSURANCE
- 8 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
9 manufacturer.
- 10 B. Mockups: Build mockups to set quality standards for materials and execution.
- 11 1. Build integrated mockups of exterior wall assembly, 150 sq. ft. (14 sq. m), incorporating backup wall
12 construction, external cladding, window, storefront, door frame and sill, insulation, ties and other
13 penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air
14 barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
- 15
- 16 a. Include junction with roofing membrane and building corner condition.
- 17 b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply
18 air barrier until mockups are approved.
- 19 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
20 mockups unless Architect specifically approves such deviations in writing.
- 21 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if
22 undisturbed at time of Substantial Completion.
- 23 1.8 DELIVERY, STORAGE, AND HANDLING
- 24 A. Remove and replace liquid materials that cannot be applied within their stated shelf life.
- 25 B. Protect stored materials from direct sunlight.
- 26 1.9 FIELD CONDITIONS
- 27 A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended
28 in writing by air-barrier manufacturer.
- 29 1. Protect substrates from environmental conditions that affect air-barrier performance.
- 30 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1 PART 2 - PRODUCTS

2 2.1 MATERIALS

3 A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single
4 manufacturer.

5 2.2 PERFORMANCE REQUIREMENTS

6 A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing
7 as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental
8 condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement
9 and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions
10 at perimeter conditions without deterioration and air leakage exceeding specified limits.

11 B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of
12 surface area at 75 Pa), when tested according to ASTM E 2357.

13 2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

14 A. High-Build, Vapor-Retarding Air Barrier: Modified bituminous or synthetic polymer membrane with an installed dry
15 film thickness, according to manufacturer's written instructions, of 40 mils (0.9 mm) or thicker over smooth, void-
16 free substrates.

17 1. Modified Bituminous Type or Synthetic Polymer Type:

- 18 a. Available Products: Subject to compliance with requirements, provide Air-Bloc 21 FR by Henry
19 Company or 47 comparable product including but not limited to the following:
20 1) Carlisle Coatings & Waterproofing Inc.
21 2) W. R. Grace & Co.
22 3) W. R. Meadows, Inc.

23 2. Physical and Performance Properties:

- 24 a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of
25 surface area at 75-Pa) pressure difference; ASTM E 2178.
26 b. Vapor Permeance: Maximum 0.05 perm; ASTM E 96/E 96M, Desiccant Method.
27 c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.
28 d. Adhesion to Substrate: Minimum 15 lbf/sq. in. when tested according to ASTM D 4541 for CMU
29 substrates and 30 lbf/sq. in. when tested according to ASTM D 4541 for all other substrates.
30 e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
31 f. UV Resistance: Can be exposed to sunlight for 30 days according to manufacturer's written
32 instructions.

33 2.4 ACCESSORY MATERIALS

34 A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants,
35 counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials,
36 adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by
37 air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-
38 barrier material and adjacent construction to which they may seal.

39 B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

1 C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch (0.64 mm) thick, and Series 300 stainless-steel
2 fasteners.

3 PART 3 - EXECUTION

4 3.1 EXAMINATION

5 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other
6 conditions affecting performance of the Work.

- 7 1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
- 8 2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier
9 manufacturer.
- 10 3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by
11 plastic sheet method according to ASTM D 4263.
- 12 4. Verify that masonry joints are flush and completely filled with mortar.

13 B. Proceed with installation only after unsatisfactory conditions have been corrected.

14 3.2 SURFACE PREPARATION

15 A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written
16 instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

17 B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other
18 construction.

19 C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants
20 or film-forming coatings from concrete.

21 D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in
22 concrete with substrate-patching material.

23 E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

24 F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a
25 smooth transition from one plane to another.

26 G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel
27 sheet mechanically fastened to structural framing to provide continuous support for air barrier.

28 H. Bridge isolation joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier
29 accessory material that accommodates joint movement according to manufacturer's written instructions and
30 details.

31 3.3 ACCESSORIES INSTALLATION

32 A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal
33 with adjacent construction and ensure continuity of air and water barrier.

- 34 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure
35 continuity of air barrier with roofing membrane.

- 1 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of
2 coverage is achieved over each substrate.
- 3 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate
4 and allow it to dry.
- 5 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by
6 air-barrier material on same day. Reprime areas exposed for more than 24 hours.

- 7 B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-
8 grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems,
9 storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings,
10 using accessory materials.

- 11 C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

- 12 D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application
13 temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

- 14 E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply
15 transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate. Maintain 3
16 inches (75 mm) of full contact over firm bearing to perimeter frames, with not less than 1 inch (25 mm) of full
17 contact.

- 18 1. Transition Strip: Roll firmly to enhance adhesion.

- 19 F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous
20 penetrations of air-barrier material with foam sealant.

- 21 G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

- 22 H. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.

- 23 I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal
24 counterflashings or ending in reglets with termination mastic.

- 25 J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and
26 blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

27 3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

- 28 A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier
29 according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within
30 manufacturer's recommended application temperature ranges.

- 31 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate
32 and allow it to dry.
- 33 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for
34 more than 24 hours.
- 35 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between
36 coats.

- 37 B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following
38 thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

- 39 1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by
40 manufacturer to comply with performance requirements, but not less than 40 mils (1.0 mm), applied in
41 multiple, overlapping coats.

- 1 C. Do not cover air barrier until it has been tested and inspected by testing agency.
- 2 D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply
3 air-barrier components.

4 3.5 FIELD QUALITY CONTROL

- 5 A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- 6 B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with
7 requirements. Inspections may include the following:

- 8 1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
- 9 2. Air-barrier dry film thickness.
- 10 3. Continuous structural support of air-barrier system has been provided.
- 11 4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
- 12 5. Site conditions for application temperature and dryness of substrates have been maintained.
- 13 6. Maximum exposure time of materials to UV deterioration has not been exceeded.
- 14 7. Surfaces have been primed, if applicable.
- 15 8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in
16 the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
- 17 9. Termination mastic has been applied on cut edges.
- 18 10. Strips and transition strips have been firmly adhered to substrate.
- 19 11. Compatible materials have been used.
- 20 12. Transitions at changes in direction and structural support at gaps have been provided.
- 21 13. Connections between assemblies (air-barrier and sealants) have complied with requirements for
22 cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
- 23 14. All penetrations have been sealed.

- 24 C. Tests: As determined by testing agency from among the following tests:
- 25 1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to
26 ASTM E 1186, chamber depressurization using detection liquids.
 - 27 2. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to
28 ASTM D 4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

- 29 D. Air barriers will be considered defective if they do not pass tests and inspections.
- 30 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection
31 results indicate insufficient thickness.
 - 32 2. Remove and replace deficient air-barrier components for retesting as specified above.

33 E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

34 F. Prepare test and inspection reports.

35 3.6 CLEANING AND PROTECTION

36 A. Protect air-barrier system from damage during application and remainder of construction period, according to
37 manufacturer's written instructions.

- 38 1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by
39 manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier
40 or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed
41 materials according to air-barrier manufacturer's written instructions.

- 1 2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier
- 2 manufacturer.

- 3 B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning
- 4 agents and procedures recommended in writing by manufacturer of affected construction.

- 5 C. Remove masking materials after installation.

- 6 END OF SECTION 072726

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1 SECTION 074213.13 - FORMED METAL WALL AND SOFFIT PANELS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Concealed-fastener, hook and strap metal wall panels.
9 2. Concealed-fastener, metal soffit panels.

10 1.3 PREINSTALLATION MEETINGS

- 11 A. Preinstallation Conference: Conduct conference at Project site.

- 12 1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's
13 representative, structural-support Installer, and installers whose work interfaces with or affects metal
14 panels, including installers of doors, windows, and louvers.
15 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel,
16 equipment, and facilities needed to make progress and avoid delays.
17 3. Review methods and procedures related to metal panel installation, including manufacturer's written
18 instructions.
19 4. Examine support conditions for compliance with requirements, including alignment between and
20 attachment to structural members.
21 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction
22 that affect metal panels.
23 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if
24 applicable.
25 7. Review temporary protection requirements for metal panel assembly during and after installation.
26 8. Review of procedures for repair of metal panels damaged after installation.
27 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to
28 each participant.

29 1.4 ACTION SUBMITTALS

- 30 A. Product Data: For each type of product.

- 31 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
32 finishes for each type of panel and accessory.

- 33 B. Sustainable Design Submittals:

- 34 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
35 by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each
36 product having recycled content.

1 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
2 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
3 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
4 material, and fraction by weight that is considered regional.

5 C. Shop Drawings:

6 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles,
7 corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
8 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2
9 inches per 12 inches (1:10).

10 D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

11 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal
12 panel accessories.

13 1.5 INFORMATIONAL SUBMITTALS

14 A. Qualification Data: For Installer.

15 B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

16 C. Field quality-control reports.

17 D. Sample Warranties: For special warranties.

18 1.6 CLOSEOUT SUBMITTALS

19 A. Maintenance Data: For metal panels to include in maintenance manuals.

20 1.7 QUALITY ASSURANCE

21 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
22 manufacturer.

23 B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects
24 and set quality standards for fabrication and installation.

25 1. Build mockup of typical metal panel assembly, including corner, soffits, fascia, supports, attachments, and
26 accessories.

27 2. Water-Spray Test: Conduct water-spray test of metal panel assembly mockup, testing for water penetration
28 according to AAMA 501.2.

29 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
30 mockups unless Architect specifically approves such deviations in writing.

31 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
32 undisturbed at time of Substantial Completion.

33 1.8 DELIVERY, STORAGE, AND HANDLING

34 A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package
35 metal panels for protection during transportation and handling.

- 1 B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- 2 C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering.
- 3 Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in
- 4 contact with other materials that might cause staining, denting, or other surface damage.
- 5 D. Retain strippable protective covering on metal panels during installation.

6 1.9 FIELD CONDITIONS

- 7 A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit
- 8 assembly of metal panels to be performed according to manufacturers' written instructions and warranty
- 9 requirements.

10 1.10 COORDINATION

- 11 A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other
- 12 adjoining work to provide a leakproof, secure, and noncorrosive installation.

13 1.11 WARRANTY

- 14 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of
- 15 metal panel systems that fail in materials or workmanship within specified warranty period.

- 16 1. Failures include, but are not limited to, the following:

- 17 a. Structural failures including rupturing, cracking, or puncturing.
- 18 b. Deterioration of metals and other materials beyond normal weathering.

- 19 2. Warranty Period: Two years from date of Substantial Completion.

- 20 B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or
- 21 replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty
- 22 period.

- 23 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- 24 a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- 25 b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- 26 c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

- 27 2. Finish Warranty Period: 30 years from date of Substantial Completion.

28 PART 2 - PRODUCTS

29 2.1 PERFORMANCE REQUIREMENTS

- 30 A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads,
- 31 based on testing according to ASTM E 1592:

- 32 1. Wind Loads: As indicated on Drawings.

- 1 2. Other Design Loads: As indicated on Drawings.
- 2 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

- 3 B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to
- 4 ASTM E 283 at the following test-pressure difference:

- 5 1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

- 6 C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the
- 7 following test-pressure difference:

- 8 1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa) [6.24 lbf/sq. ft. (300 Pa)].

- 9 D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing
- 10 buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other
- 11 detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and
- 12 nighttime-sky heat loss.

- 13 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- 14 2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

- 15 A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side
- 16 edges of adjacent panels and mechanically attaching panel to supports using concealed fasteners in side laps.
- 17 Include accessories required for weathertight installation.

- 18 B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical and horizontal panel edges and a flat pan
- 19 between panel edges; with lap joint between panels.

- 20 1. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with
- 21 temper as required to suit forming operations and structural performance required.

- 22 a. Thickness: 0.032 inch (0.81 mm).
- 23 b. Surface: Smooth, flat finish.
- 24 c. Exterior Finish: Two-coat fluoropolymer.
- 25 d. Color: Match Architect's samples.
- 26 1) Refer to drawings for color locations. 2 colors required.

- 27 2. Panel Coverage: 60 inches unless noted otherwise on drawings.
- 28 3. Panel Height: 8-inches or 16-inches as indicated on the drawings.
- 29 4. Panel orientation: Horizontal in pattern/layout indicated.

- 30 2.3 CONCEALED-FASTENER, METAL SOFFIT PANELS

- 31 A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent
- 32 panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include
- 33 accessories required for weathertight installation.

- 34 B. Metal Soffit Panels:
- 35 1. Match material of metal wall panels.
- 36 2. Finish: Match finish metal wall panels.
- 37 3. Color: Match Architect's samples.
- 38 4. Sealant: Factory applied within interlocking joint.
- 39 4. Sealant: Factory applied within interlocking joint.

1 C. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges;
2 with flush joint between panels.

- 3 1. Panel Coverage: 12 inches (305 mm).
- 4 2. Panel Height: 0.875 inch (22 mm).

5 2.4 MISCELLANEOUS MATERIALS

6 A. Miscellaneous Metal Subframing: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 1046, Class ZM40
7 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as
8 required for support and alignment of metal panel system.

- 9
- 10 1. Steel Classification: Structural Steel (SS), Grade 50, 50 ksi Yield
- 11 2. Spacing: Comply with manufacturer's Professional Engineer's calculations.
- 12 3. Horizontal Girt: Stiffened horizontal girt with pre-punched drainage holes, directly attached on top of rigid
13 insulation at regular spacing, with engineered thermally isolated washer assembly and fasteners.
- 14 4. Steel Thickness: Minimum 0.046-inch thick (18 gauge).
- 15 5. Profile Depth: 0.75 inches.
- 16 6. Girt Fastening Face: 2-inches.
- 17 7. Overall Girt Profile: 5-1/8-inches.
- 18 8. Basis of Design: HCI™ by Knight Wall Systems.

19 B. Miscellaneous Metal Subframing Fasteners:

- 20
- 21 1. Sufficient length to provide solid attachment through rigid insulation to structure as required by
22 manufacturer.
- 23 2. Thermal Isolating Washers: Minimum 0.125 inch thick Polyoxymethylene copolymer (POM) washers with
24 integral centering lip to act as a thermal break between wall anchor fasteners and girt.
- 25 3. Tensile Yield Strength: 9.57 ksi per ISO 527.
- 26 4. Melting Temperature: 329 degrees Fahrenheit per ISO 3146.
- 27 5. Basis of Design: ThermaStop™ Isolator by Knight Wall Systems.
- 28 6. Steel stud framing substrate: Self-drill hex-washer-head stainless steel with 1,000 hour salt-spray rated
29 thermoset polyester coating.
 - 30 a. Embedment depth: 0.625 inches or three full threads minimum, whichever is greater.
 - 31 b. Minimum ultimate pull-out capacity from 18 gauge steel: 450 pounds.
- 32 7. Concrete and concrete masonry units substrate:
 - 33 a. Embedment depth: 1.25 inches minimum.
 - 34 b. Minimum ultimate pull-out capacity from substrate material: 450 pounds.
 - 35 c. 1/4 inch Kwik-Con II+ by Hilti, 1/4 inch Tapcon by Buildex, or 1/4 inch UltraCon by Elco Industries.

36 C. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings,
37 fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match
38 material and finish of metal panels unless otherwise indicated.

- 39 1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
- 40 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended
41 by manufacturer.
- 42 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell
43 laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match
44 metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight
45 construction.

46 D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against
47 weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs,
48 corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim
49 with same finish system as adjacent metal panels.

- 1 E. Panel Fasteners: Screws designed to withstand design loads. Provide exposed fasteners with heads matching color
2 of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for
3 exposed fasteners.
- 4 F. Self adhering permeable underlayment
- 5
- 6 1. Self-adhered, water-resistive, vapour permeable underlayment membrane, components, and accessories.
7 2. Products: Subject to compliance with requirements, provide VaproShield; SlopeShield SA or comparable
8 product that may be incorporated into the Work include, but are not limited to products manufactured by
9 the following:
- 10 a. Carlisle Coatings & Waterproofing Inc.
11 b. Grace, W. R. & Co. - Conn.
12 c. Henry Company.
13 d. Meadows, W. R., Inc.
14 e. Tremco Incorporated, an RPM company.
- 15 3. Membrane shall have the following physical properties:
16 a. Tensile Strength: Pass ASTM D1682 and tested in accordance with ICC-ES AC 48.
17 b. Water Vapor Permeance: 59 perms to ASTM E96, Method B.
18 c. Liquid Water Transmission: Pass ASTM D 4869.
19 d. Air leakage: <0.004 CFM/ft² @ 1.57 lbs/ft² when tested in accordance with ASTM E2178.
20 e. Water Resistance - Ponding: Pass AC 48, Section 4.4
- 21 4. Transition Membrane: Self-adhered flashing membrane. Vapor permeable water-resistive sheet membrane
22 consisting of multiple layers of UV stabilized spun-bonded polyethylene having properties equal to the
23 primary water-resistive underlayment membrane.
- 24 G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are
25 nonstaining, and do not damage panel finish.
- 26 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with
27 release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)**
28 wide and **1/8 inch (3 mm)** thick.
29 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use
30 classifications required to seal joints in metal panels and remain weathertight; and as recommended in
31 writing by metal panel manufacturer.
32 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

33 2.5 FABRICATION

- 34 A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures
35 and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing.
36 Comply with indicated profiles and with dimensional and structural requirements.
- 37 B. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and
38 recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and
39 other characteristics of item indicated.
- 40 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and
41 that are true to line and levels indicated, with exposed edges folded back to form hems.
42 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy
43 seam sealer. Rivet joints for additional strength.
44 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges
45 to be seamed, form seams, and solder.
46 4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply
47 with SMACNA standards.
48 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of
49 accessories exposed to view.

1 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from
2 compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

3 a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel
4 manufacturer for application but not less than thickness of metal being secured.

5 2.6 FINISHES

6 A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary
7 protective covering before shipping.

8 B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are
9 within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable.
10 Variations in appearance of other components are acceptable if they are within the range of approved Samples and
11 are assembled or installed to minimize contrast.

12 C. Aluminum Panels and Accessories:

13 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin
14 by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with
15 coating and resin manufacturers' written instructions.

16 PART 3 - EXECUTION

17 3.1 EXAMINATION

18 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
19 tolerances, metal panel supports, and other conditions affecting performance of the Work.

20 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support
21 members and anchorage have been installed within alignment tolerances required by metal wall panel
22 manufacturer.

23 2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation
24 is within flatness tolerances required by metal panel manufacturer.

25 a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to
26 prevent air infiltration or water penetration.

27 B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of
28 penetrations relative to seam locations of metal panels before installation.

29 C. Proceed with installation only after unsatisfactory conditions have been corrected.

30 3.2 PREPARATION

31 A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and
32 anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

1 3.3 METAL PANEL INSTALLATION

2 A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations
3 indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other
4 components of the Work securely in place, with provisions for thermal and structural movement.

- 5 1. Shim or otherwise plumb substrates receiving metal panels.
- 6 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin
7 installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are
8 installed.
- 9 3. Install screw fasteners in predrilled holes.
- 10 4. Locate and space fastenings in uniform vertical and horizontal alignment.
- 11 5. Install flashing and trim as metal panel work proceeds.
- 12 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to
13 avoid a four-panel lap splice condition.
- 14 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings
15 and trim around openings and similar elements with self-tapping screws.
- 16 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

17 B. Fasteners:

- 18 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use
19 aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

21 C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic
22 action as recommended in writing by metal panel manufacturer.

23 D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing
24 recommended by manufacturer.

- 25 1. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
- 26 2. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain
27 controlled uniform compression for positive seal without rupture of washer.
- 28 3. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly
29 without damage to washer, screw threads, or panels. Install screws in predrilled holes.
- 30 4. Flash and seal panels with weather closures at perimeter of all openings.

32 E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and
33 provide for thermal expansion. Coordinate installation with flashings and other components.

- 34 1. Install components required for a complete metal panel system including trim, copings, corners, seam
35 covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal
36 wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

37 F. COLD-FORMED METAL FRAMING INSTALLATION

- 38 1. Preparation: Verify horizontal girt does not cantilever past rigid insulation.
- 39 2. Install in strict accordance with manufacturer's installation instructions.
- 40 3. Use laser or chalk line to mark starting height of horizontal girt.
- 41 4. Do not use shims to plumb the wall between the horizontal girt and insulation.
- 42 5. Minimum length of installed cut girt is 24-inches and shall be attached with at least two (2) fasteners.
- 43 6. Mount stiffened horizontal girts, fastened up to 36 inches on center (as determined by the manufactures
44 engineering calculations) over installed rigid insulation, using one self-tapping screw with thermal isolator,
45 for each pre-punched attachment hole at spacing indicated on engineering calculations.
- 46 a. Check plumb of horizontal girts both parallel and perpendicular to the structure.
- 47 b. Tighten screws that attach horizontal girt through insulation to substructure to a snug tight
48 condition and not stripped. Do not over-torque beyond manufacturer's recommendation. If
49

- 1 installed using hand tools, verify for each installer at beginning of project using snug-tight criteria.
2 Do not use stripped holes.
- 3 c. Where obstructions are present and unavoidable (i.e. window openings), use laser or chalk line to
4 restart girt.
 - 5 d. Use shearing instruments (i.e. snips, nibbler, etc.) for cutting metal framing components. Saws are
6 not recommended, as the sparks produced during cutting will damage the anti-corrosion coating. If
7 sparks are generated during cutting, be sure the portion of the component to be installed on the
8 building is protected from sparks and that any stockpile near the cutting station is also protected.
 - 9 e. The systems components should not be cut while installed on the building, unless using a shearing
10 instrument.
 - 11 f. Replace thermal isolator pieces that break during installation.
 - 12 g. Provide a 3/8" – 1/2" gap between girts for expansion when multiple lengths of horizontal girts are
13 installed.

14 G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and
15 SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to
16 line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

- 17 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels
18 indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit
19 substrates and achieve waterproof performance.
- 20 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints
21 at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection.
22 Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion
23 joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant
24 (concealed within joints).

25 3.4 FIELD QUALITY CONTROL

- 26 A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- 27 B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according
28 to AAMA 501.2.
- 29 C. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified
30 requirements.
- 31 D. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or
32 additional work with specified requirements.
- 33 E. Prepare test and inspection reports.

34 3.5 CLEANING AND PROTECTION

- 35 A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise
36 indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean
37 finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.
- 38 B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- 39 C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or
40 similar minor repair procedures.

41 END OF SECTION 074213.13

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1 SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
9 2. Vapor retarder.
10 3. Roof insulation.
11 4. Walkways.

12 B. Related Requirements:

- 13 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
14 2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
15 3. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

16 1.3 DEFINITIONS

- 17 A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane
18 Roof Systems" apply to work of this Section.

19 1.4 PREINSTALLATION MEETINGS

20 A. Preinstallation Roofing Conference: Conduct conference at Project site.

- 21 1. Meet with Owner, Architect, City Construction Manager, testing and inspecting agency representative,
22 roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and
23 installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-
24 mounted equipment.
25 2. Review methods and procedures related to roofing installation, including manufacturer's written
26 instructions.
27 3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel,
28 equipment, and facilities needed to make progress and avoid delays.
29 4. Examine deck substrate conditions and finishes, including flatness and fastening.
30 5. Review structural loading limitations of roof deck during and after roofing.
31 6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and
32 condition of other construction that affects roofing system.
33 7. Review governing regulations and requirements for insurance and certificates if applicable.
34 8. Review temporary protection requirements for roofing system during and after installation.
35 9. Review roof observation and repair procedures after roofing installation.

- 1 1.5 ACTION SUBMITTALS
- 2 A. Product Data: For each type of product.
- 3 1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.
- 4 B. Sustainable Design Submittals:
- 5 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
- 6 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
- 7 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
- 8 material, and fraction by weight that is considered regional.
- 9 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
- 10 by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each
- 11 product having recycled content.
- 12 C. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
- 13 1. Layout and thickness if insulation.
- 14 2. Base flashings and membrane terminations.
- 15 3. Flashing details at penetrations.
- 16 4. Tapered insulation, thickness, and slopes.
- 17 5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings
- 18 and patterns for mechanically fastened roofing components.
- 19 6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
- 20 7. Tie-in with air barrier.
- 21 D. Samples for Verification: For the following products:
- 22 1. Roof membrane and flashings of color required.
- 23 2. Walkway pads or rolls, of color required.
- 24 E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance
- 25 requirements.
- 26 1.6 INFORMATIONAL SUBMITTALS
- 27 A. Qualification Data: For Installer and manufacturer.
- 28 B. Manufacturer Certificates:
- 29 1. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied
- 30 under this Section are acceptable for special warranty.
- 31 C. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing
- 32 agency, indicating compliance with specified requirements.
- 33 D. Evaluation Reports: For components of roofing system, from ICC-ES.
- 34 E. Field quality-control reports.
- 35 F. Sample Warranties: For manufacturer's special warranties.
- 36 1.7 CLOSEOUT SUBMITTALS
- 37 A. Maintenance Data: For roofing system to include in maintenance manuals.

- 1 1.8 QUALITY ASSURANCE
- 2 A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for
3 this Project.
- 4 B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to
5 install manufacturer's product and that is eligible to receive manufacturer's special warranty.
- 6 1.9 DELIVERY, STORAGE, AND HANDLING
- 7 A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's
8 name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for
9 storing and mixing with other components.
- 10 B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the
11 temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
- 12 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- 13 C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and
14 other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling,
15 storing, and protecting during installation.
- 16 D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.
- 17 1.10 FIELD CONDITIONS
- 18 A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit
19 roofing system to be installed according to manufacturer's written instructions and warranty requirements.
- 20 1.11 WARRANTY
- 21 A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or
22 workmanship within specified warranty period.
- 23 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners and other components
24 of roofing system.
- 25 2. Warranty Period: 30 years from Date of Substantial Completion.
- 26 B. Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work
27 of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation,
28 fasteners, vapor retarders, and walkway products, for the following warranty period:
- 29 1. Warranty Period: Two years from Date of Substantial Completion.

1 PART 2 - PRODUCTS

2 2.1 PERFORMANCE REQUIREMENTS

3 A. General Performance: Installed roofing system and base flashings shall withstand specified uplift pressures,
4 thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication,
5 installation, or other defects in construction. Roofing and flashings shall remain watertight.

- 6 1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to
7 ASTM G 152, ASTM G 154, or ASTM G 155.
8 2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D 3746,
9 ASTM D 4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

10 B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under
11 conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing
12 and field experience.

13 C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to
14 FM Approvals 4474, UL 580, or UL 1897:

- 15 1. Zone 1 (Roof Area Field):
16 a. Wind Pressure: 17 lbf/sq. ft.
17 b. Wind Uplift Ratings: 60 lbf/sq. ft.
18
19 2. Zone 2 (Roof Area Perimeter):
20 a. Wind Pressure: 28 lbf/sq. ft.
21 b. Wind Uplift Ratings: 60 lbf/sq. ft.
22
23 3. Zone 3 (Roof Area Corners):
24 a. Wind Pressure: 42 lbf/sq. ft.
25 b. Wind Uplift Ratings: 90 lbf/sq. ft.

26 D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class C; for application and roof slopes indicated; testing by a
27 qualified testing agency. Identify products with appropriate markings of applicable testing agency.

28 2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

29 A. EPDM Sheet: ASTM D 4637/D 4637M, Type I, nonreinforced, EPDM sheet.

- 30 1. Thickness: 90 mils, nominal.
31 2. Exposed Face Color: Black.
32 3. Source Limitations: Obtain components for roofing system from roof membrane manufacturer.

33 B. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be
34 incorporated into the Work include the following:

- 35 1. Carlisle SynTec Incorporated.
36 2. Firestone Building Products.
37

38 2.3 AUXILIARY ROOFING MATERIALS

39 A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with
40 other roofing components.

- 1 1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.
- 2 B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.
- 3 C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- 4 D. Bonding Adhesive: Manufacturer's standard.
- 5 E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum,
6 butyl splice tape with release film.
- 7 F. Lap Sealant: Manufacturer's standard, single-component sealant.
- 8 G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- 9 H. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by
10 1/8 inch (25 by 3 mm) thick; with anchors.
- 11 I. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1
12 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.
- 13 J. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions
14 in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system
15 manufacturer.
- 16 K. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot
17 flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers,
18 in-seam sealants, termination reglets, cover strips, and other accessories.
- 19 2.4 VAPOR RETARDER
- 20 A. Polyethylene Film: ASTM D 4397, 6 mils (0.015 mm) thick, minimum, with maximum permeance rating of 0.076
21 perm (0.050 metric perm).
- 22 1. Tape: Pressure-sensitive tape of type recommended by vapor retarder manufacturer for sealing joints and
23 penetrations in vapor retarder.
- 24 2.5 ROOF INSULATION
- 25 A. General: Preformed roof insulation boards manufactured by EPDM roof membrane manufacturer.
- 26 B. Sustainability Requirements: Provide rigid insulation as follows:
- 27 1. Recycled Content of rigid insulation Products: Preconsumer recycled content not less than 20 percent.
- 28 2. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both
29 major surfaces.
- 30 1. Compressive Strength: 20 psi (138 kPa) minimum.
- 31 2. Size: 48 by 48 inches (1219 by 1219 mm).
- 32 3. Thickness:
- 33 a. Base Layer: 2-1/2 inches (38 mm).
- 34 b. Upper Layer: 2-1/2 inches.
- 35 3. Thickness:
- 36 a. Base Layer: 2-1/2 inches (38 mm).
- 36 b. Upper Layer: 2-1/2 inches.

- 1 D. Tapered Insulation: Provide factory-tapered insulation boards.
- 2 1. Material: Match roof insulation.
- 3 2. Minimum Thickness: 1/4 inch (6.35 mm).
- 4 3. Slope:
- 5 a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
- 6 b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.
- 7 2.6 INSULATION ACCESSORIES
- 8 A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility
- 9 with other roofing system components.
- 10 B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions
- 11 in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system
- 12 manufacturer.
- 13 C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to
- 14 substrate or to another insulation layer. Provide one of the following:
- 15 1. Modified asphaltic, asbestos-free, cold-applied adhesive.
- 16 2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
- 17 3. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- 18 2.7 WALKWAYS
- 19 A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls,
- 20 approximately 3/16 inch (5 mm) thick and acceptable to roofing system manufacturer.
- 21 1. Size: Approximately 36 by 60 inches (914 by 1524 mm).
- 22 2. Color: Contrasting with roof membrane.
- 23 PART 3 - EXECUTION
- 24 3.1 EXAMINATION
- 25 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other
- 26 conditions affecting performance of the Work.
- 27 1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are
- 28 securely clamped in place.
- 29 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and
- 30 terminations and that nailers match thicknesses of insulation.
- 31 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in
- 32 Section 053100 "Steel Decking."
- 33 B. Proceed with installation only after unsatisfactory conditions have been corrected.

- 1 3.2 PREPARATION
- 2 A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according
3 to roofing system manufacturer's written instructions. Remove sharp projections.
- 4 B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto
5 surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- 6 3.3 ROOFING INSTALLATION, GENERAL
- 7 A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav
8 assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.
- 9 B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed
10 sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before
11 beginning work on adjoining roofing.
- 12 C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier
13 specified under Section 072726 "Fluid-Applied Membrane Air Barriers."
- 14 3.4 VAPOR RETARDER INSTALLATION
- 15 A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder,
16 side and end lapping each sheet a minimum of 2 and 6 inches (50 and 150 mm), respectively.
- 17 1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and
18 cover board.
- 19 2. Continuously seal side and end laps with tape.
- 20 B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into
21 roofing system.
- 22 3.5 INSULATION INSTALLATION
- 23 A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end
24 of workday.
- 25 B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- 26 C. Installation Over Metal Decking:
- 27 1. Install base layer of insulation with joints staggered not less than 24 inches (610 mm) in adjacent rows.
- 28 a. Locate end joints over crests of decking.
- 29 b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting
30 sloping roof decks.
- 31 c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
- 32 d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the
33 diameter of the drain bowl plus 24 inches (610 mm).
- 34 1) Trim insulation so that water flow is unrestricted.
- 35 e. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
- 36 f. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

- 1 g. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and
2 sized for fastening specified board-type roof insulation to metal decks.
3
4 1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
- 5 2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12
6 inches (305 mm) from previous layer of insulation.
- 7 a. Staggered end joints within each layer not less than 24 inches (610 mm) in adjacent rows.
8 b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting
9 sloping roof decks.
10 c. Make joints between adjacent insulation boards not more than 1/4 inch (6 mm) in width.
11 d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the
12 diameter of the drain bowl plus 24 inches (610 mm).
13 e. Trim insulation so that water flow is unrestricted.
14 f. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
15 g. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
16 h. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav
17 assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified
18 Windstorm Resistance Classification, as follows:
19
- 20 1) Set each layer of insulation in ribbons of bead-applied insulation adhesive or uniform
21 coverage of full-spread of bead-applied insulation adhesive as required by installation,
22 firmly pressing and maintaining insulation in place.

23 3.6 ADHERED ROOFING INSTALLATION

- 24 A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written
25 instructions.
- 26 B. Unroll membrane roof membrane and allow to relax before installing.
- 27 C. Start installation of roofing in presence of roofing system manufacturer's technical personnel.
- 28 D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by
29 manufacturer. Stagger end laps.
- 30 E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow
31 to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.
- 32 F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.
- 33 G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- 34 H. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.
- 35 1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
36 2. Apply lap sealant and seal exposed edges of roofing terminations.
- 37 I. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- 38 J. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roof membrane in place with
39 clamping ring.

- 1 3.7 BASE FLASHING INSTALLATION
- 2 A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system
3 manufacturer's written instructions.
- 4 B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do
5 not apply to seam area of flashing.
- 6 C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- 7 D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a
8 watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- 9 E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
- 10 3.8 WALKWAY INSTALLATION
- 11 A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
- 12 1. Install flexible walkways at the following locations:
13
14 a. Locations indicated on Drawings.
15 b. As required by roof membrane manufacturer's warranty requirements.
- 16 2. Provide 6-inch (76-mm) clearance between adjoining pads.
17 3. Adhere walkway products to substrate with compatible adhesive according to roofing system
18 manufacturer's written instructions.
- 19 3.9 FIELD QUALITY CONTROL
- 20 A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation
21 on completion, in presence of the City's Construction Manager, and to prepare inspection report.
- 22 B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply
23 with specified requirements.
- 24 C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional
25 work complies with specified requirements.
- 26 3.10 PROTECTING AND CLEANING
- 27 A. Protect roofing system from damage and wear during remainder of construction period. When remaining
28 construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage,
29 describing its nature and extent in a written report, with copies to Architect and Owner.
- 30 B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and
31 repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion
32 and according to warranty requirements.
- 33 END OF SECTION 075323

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1 SECTION 076200 - SHEET METAL FLASHING AND TRIM

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8
9 1. Formed roof-drainage sheet metal fabrications.
10 2. Formed low-slope roof sheet metal fabrications.

11 B. Related Requirements:

- 12 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
13 2. Section 074213.13 Formed Metal Wall and Soffit Panels for sheet metal flashing and trim integral with
14 metal wall panels.
15 3. Section 077200 "Roof Accessories" for roof hatches and other manufactured roof accessory units.

16 1.3 COORDINATION

- 17 A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed,
18 and joints and seams in adjacent materials.

- 19 B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to
20 provide leakproof, secure, and noncorrosive installation.

21 1.4 PREINSTALLATION MEETINGS

- 22 A. Preinstallation Conference: Conduct conference at Project site.

- 23 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities
24 needed to make progress and avoid delays.
25 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of
26 other construction that affect sheet metal flashing and trim.
27 3. Review requirements for insurance and certificates if applicable.
28 4. Review sheet metal flashing observation and repair procedures after flashing installation.

29 1.5 ACTION SUBMITTALS

- 30 A. Product Data: For each type of product.

- 31 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
32 finishes for each manufactured product and accessory.

- 1 B. Sustainable Design Submittals:
2
3 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
4 by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each
5 product having recycled content.
- 6 C. Shop Drawings: For sheet metal flashing and trim.
- 7 1. Include plans, elevations, sections, and attachment details.
8 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between
9 shop- and field-assembled work.
10 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
11 4. Include details for forming, including profiles, shapes, seams, and dimensions.
12 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips,
13 and other attachments. Include pattern of seams.
14 6. Include details of termination points and assemblies.
15 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and
16 contraction from fixed points.
17 8. Include details of roof-penetration flashing.
18 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as
19 applicable.
20 10. Include details of special conditions.
21 11. Include details of connections to adjoining work.
22 12. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches (1:5).
- 23 D. Samples for Verification: For each type of exposed finish.
- 24 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in
25 required profile. Include fasteners, cleats, clips, closures, and other attachments.
26 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300
27 mm) long and in required profile. Include fasteners and other exposed accessories.
28 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
- 29 1.6 INFORMATIONAL SUBMITTALS
- 30 A. Qualification Data: For fabricator.
31 B. Product Test Reports: For each product, for tests performed by a qualified testing agency.
32 C. Sample Warranty: For special warranty.
- 33 1.7 CLOSEOUT SUBMITTALS
- 34 A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- 35 1.8 QUALITY ASSURANCE
- 36 A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to
37 that required for this Project and whose products have a record of successful in-service performance.
- 38 B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and
39 to set quality standards for fabrication and installation.

- 1 1. Build mockup of typical roof edge, including fascia, approximately 10 feet (3.0 m) long, including supporting
2 construction cleats, seams, attachments and accessories.
3 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in
4 mockups unless Architect specifically approves such deviations in writing.
5 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if
6 undisturbed at time of Substantial Completion.

7 1.9 DELIVERY, STORAGE, AND HANDLING

- 8 A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining,
9 denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and
10 masonry.
11 B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high
12 humidity, except to extent necessary for period of sheet metal flashing and trim installation.

13 1.10 WARRANTY

- 14 A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that
15 shows evidence of deterioration of factory-applied finishes within specified warranty period.
16 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
17 a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
18 b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
19 c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
20 2. Finish Warranty Period: 30 years from date of Substantial Completion.

21 PART 2 - PRODUCTS

22 2.1 PERFORMANCE REQUIREMENTS

- 23 A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally
24 induced movement, and exposure to weather without failure due to defective manufacture, fabrication,
25 installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or
26 loosen, and shall remain watertight.
27 B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual"
28 requirements for dimensions and profiles shown unless more stringent requirements are indicated.
29 C. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable
30 of resisting the following design pressure:
31 1. Design Pressure: As indicated on Drawings.
32 D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent
33 buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other
34 detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and
35 nighttime-sky heat loss.
36 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

- 1 2.2 SHEET METALS
- 2 A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary
3 protective film before shipping.
- 4 B. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, alloy as standard with manufacturer for finish required, with temper
5 as required to suit forming operations and performance required; with smooth, flat surface.
- 6 1. Exposed Coil-Coated Finish:
- 7 a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent
8 PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces
9 to comply with coating and resin manufacturers' written instructions.
- 10 2. Color: 2 separate colors are required.
- 11 a. Color 1 to match metal panel where materials overlap.
- 12 b. Color 2 (at masonry where materials overlap) to be selected by Architect from Manufacture's full
13 range.
- 14
- 15 3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer
16 finish, consisting of prime coat and wash coat with minimum total dry film thickness of **0.5 mil (0.013 mm)**.
- 17 2.3 UNDERLAYMENT MATERIALS
- 18 A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; non-perforated.
- 19 B. Slip Sheet: Rosin-sized building paper, **3 lb/100 sq. ft. (0.16 kg/sq. m)** minimum.
- 20 2.4 MISCELLANEOUS MATERIALS
- 21 A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as
22 required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary
23 sheet metal unless otherwise indicated.
- 24 B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other
25 suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
- 26 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
- 27 a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied
28 coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners
29 bearing on weather side of metal.
- 30 b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
- 31
- 32 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- 33 C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper
34 backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape **1/2 inch (13 mm)** wide and **1/8 inch (3
35 mm)** thick.
- 36 D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications
37 required to seal joints in sheet metal flashing and trim and remain watertight.
- 38 E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized;
39 heavy bodied for hooked-type expansion joints with limited movement.

- 1 F. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
- 2 2.5 FABRICATION, GENERAL
- 3 A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in
4 cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of
5 item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
- 6 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance
7 requirements, but not less than that specified for each application and metal.
- 8 2. Obtain field measurements for accurate fit before shop fabrication.
- 9 3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks;
10 true to line, levels, and slopes; and with exposed edges folded back to form hems.
- 11 4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed
12 to view.
- 13 B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4**
14 **inch in 20 feet (6 mm in 6 m)** on slope and location lines indicated on Drawings and within **1/8-inch (3-mm)** offset of
15 adjoining faces and of alignment of matching profiles.
- 16 C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
- 17 1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch (25 mm)** deep, filled with butyl
18 sealant concealed within joints.
- 19 2. Use lapped expansion joints only where indicated on Drawings.
- 20 D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation
21 of elastomeric sealant according to cited sheet metal standard.
- 22 E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible,
23 noncorrosive metal.
- 24 F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but
25 not less than thickness of metal being secured.
- 26 G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless
27 otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- 28 H. Do not use graphite pencils to mark metal surfaces.
- 29 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS
- 30 A. Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, **4-inch- (100-mm-)** wide
31 wall flanges to interior, and base extending **4 inches (100 mm)** beyond cant or tapered strip into field of roof.
32 Fabricate from the following materials:
- 33 1. Aluminum: **0.040 inch** thick.
- 34 B. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and
35 shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the
36 following materials:
- 37 1. Fabricated Head Style: **Fig 1-25C** according to SMACNA's "Architectural Sheet Metal Manual."
38 2. Aluminum: **0.040** thick.

1 C. Downspouts: Fabricate open-face downspouts to dimensions indicated, complete with mitered elbows. Furnish
2 with metal hangers from **same material as downspouts and anchors.**

- 3 1. Fabricated Hanger Style: **Fig 1-35I** according to SMACNA's "Architectural Sheet Metal Manual."
- 4 2. Fabricate from the following materials:
 - 5 a. Aluminum: **0.040 inch** thick.

6 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

7 A. Roof Edge Flashing (Gravel Stop): Fabricate in minimum **96-inch- (2400-mm-)** long, but not exceeding **12-foot- (3.6-**
8 **m-)** long sections. Furnish with **6-inch- (150-mm-)** wide, joint cover plates. Shop fabricate interior and exterior
9 corners.

- 10 1. Joint Style: Butted with expansion space and **6-inch- (150-mm-)** wide, concealed backup plate.
- 11 2. Fabricate from the Following Materials:
 - 12 a. Aluminum: **0.050 inch (1.27 mm)** thick.

13 B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

- 14 1. Aluminum: **0.032 inch (0.81 mm)** thick.

15 C. Flashing Receivers: Fabricate from the following materials:

- 16 1. Aluminum: **0.032 inch (0.81 mm)** thick.

17 PART 3 - EXECUTION

18 3.1 EXAMINATION

19 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
20 tolerances, substrate, and other conditions affecting performance of the Work.

- 21 1. Verify compliance with requirements for installation tolerances of substrates.
- 22 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- 23 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to
24 prevent air infiltration or water penetration.

25 B. Proceed with installation only after unsatisfactory conditions have been corrected.

26 3.2 UNDERLAYMENT INSTALLATION

27 A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners
28 under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than **2**
29 **inches (50 mm).**

30 B. Apply slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

- 1 3.3 INSTALLATION, GENERAL
- 2 A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions
3 for thermal and structural movement. Use fasteners[, solder], protective coatings, separators, sealants, and other
4 miscellaneous items as required to complete sheet metal flashing and trim system.
- 5 1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with
6 minimum exposure of solder, welds, and sealant.
- 7 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes
8 and dimensions of surfaces to be covered before fabricating sheet metal.
- 9 3. Space cleats not more than 12 inches (300 mm) apart. Attach each cleat with at least two fasteners. Bend
10 tabs over fasteners.
- 11 4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
- 12 5. Torch cutting of sheet metal flashing and trim is not permitted.
- 13 6. Do not use graphite pencils to mark metal surfaces.
- 14 B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or
15 other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous
16 coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal
17 standard.
- 18 1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where
19 flashing and trim contact wood, ferrous metal, or cementitious construction.
- 20 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates,
21 install underlayment and cover with slip sheet.
- 22 C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at
23 maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
- 24 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with
25 sealant concealed within joints.
- 26 D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches (32 mm) for nails
27 and not less than 3/4 inch (19 mm) for wood screws.
- 28 E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of
29 leakage. Cover and seal fasteners and anchors as required for a tight installation.
- 30 F. Seal joints as required for watertight construction.
- 31 1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1
32 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of
33 installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each
34 way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-
35 type joints at temperatures below 40 deg F (4 deg C).
- 36 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- 37 G. Rivets: Rivet joints in uncoated aluminum where necessary for strength.
- 38 3.4 ROOF-DRAINAGE SYSTEM INSTALLATION
- 39 A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet
40 metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of
41 roof-drainage system.

- 1 B. Scuppers: Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or
2 tapered edge strips, and under roofing membrane.
- 3 1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
4 2. Loosely lock front edge of scupper with conductor head.
- 5 C. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of **1 inch (25 mm)**
6 below scupper discharge.
- 7 3.5 ROOF FLASHING INSTALLATION
- 8 A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal
9 manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where
10 possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently
11 watertight and weather resistant.
- 12 B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal
13 standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to
14 substrate at staggered **3-inch (75-mm)** centers.
- 15 C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing
16 in reglets or receivers and fit tightly to base flashing. Extend counterflashing **4 inches (100 mm)** over base flashing.
17 Lap counterflashing joints minimum of **4 inches (100 mm)**. Secure in waterproof manner by means of interlocking
18 folded seam or blind rivets and sealant unless otherwise indicated.
- 19 3.6 ERECTION TOLERANCES
- 20 A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of **1/4 inch in 20 feet**
21 **(6 mm in 6 m)** on slope and location lines indicated on Drawings and within **1/8-inch (3-mm)** offset of adjoining
22 faces and of alignment of matching profiles.
- 23 B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's
24 "Guide Specification for Residential Metal Roofing."
- 25 3.7 CLEANING AND PROTECTION
- 26 A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- 27 B. Clean off excess sealants.
- 28 C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless
29 otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and
30 trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and
31 trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.
- 32 D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair
33 by finish touchup or similar minor repair procedures.
- 34 END OF SECTION 076200

1 SECTION 077200 - ROOF ACCESSORIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Roof hatches.

- 9 B. Related Sections:

- 10 1. Section 055000 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof
11 hatches.
12 2. Section 076200 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage
13 systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

14 1.3 COORDINATION

- 15 A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and
16 adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

- 17 B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

18 1.4 ACTION SUBMITTALS

- 19 A. Product Data: For each type of roof accessory.

- 20 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
21 finishes.

- 22 B. Sustainable Design Submittals:

- 23 1. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
24 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
25 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
26 material, and fraction by weight that is considered regional.
27 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
28 by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each
29 product having recycled content.
30 3. Product Certificates for Credit EQ 4.1: Product data for adhesives and sealants, including printed statement
31 of VOC content.

- 32 C. Shop Drawings: For roof accessories.

1 1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and
2 special conditions. Distinguish between plant- and field-assembled work.

3 D. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to
4 adequately show color.

5 1.5 INFORMATIONAL SUBMITTALS

6 A. Sample Warranties: For manufacturer's special warranties.

7 1.6 CLOSEOUT SUBMITTALS

8 A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

9 1.7 WARRANTY

10 A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair
11 finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified
12 warranty period.

13 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

- 14 a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- 15 b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- 16 c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

17 2. Finish Warranty Period: 20 years from date of Substantial Completion.

18 PART 2 - PRODUCTS

19 2.1 PERFORMANCE REQUIREMENTS

20 A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced
21 movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication,
22 installation, or other defects in construction.

23 2.2 ROOF HATCH

24 A. Roof Hatches: Metal roof-hatch units with lids and insulated-walled curbs, welded or mechanically fastened and
25 sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally
26 formed deck-mounting flange at perimeter bottom.

27
28 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
29 may be incorporated into the Work include, but are not limited to, the following:

- 30 a. AES Industries, Inc.
- 31 b. Babcock-Davis.
- 32 c. Bilco Company (The).
- 33 d. Bristolite Skylights.
- 34 e. Custom Solution Roof and Metal Products.
- 35 f. Dur-Red Products.
- 36 g. Hi Pro International, Inc.

- 1 h. J. L. Industries, Inc.
2 i. Metallic Products Corp.
3 j. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
4 k. Naturalite Skylight Systems; Vistawall Group (The).
5 l. Nystrom.
6 m. O'Keeffe's Inc.
7 n. Pate Company (The).
8 o. Precision Ladders, LLC.
- 9 B. Type and Size: Single-leaf lid, **36 by 36 inches**.
- 10 C. Loads: Minimum **40-lbf/sq. ft. (1.9-kPa)** external live load and **20-lbf/sq. ft. (0.95-kPa)** internal uplift load.
- 11 D. Hatch Material: Aluminum sheet.
- 12 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
13 2. Finish: Mill.
- 14 E. Construction:
- 15 1. Insulation: Polyisocyanurate board.
- 16 a. R-Value: 18.0 according to ASTM C 1363.
- 17 2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
18 3. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material
19 and finish as outer metal lid.
20 4.
21 5. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
22 6. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
23 7. Fabricate curbs to minimum height of **12 inches (305 mm)** above roofing surface unless otherwise indicated.
24 8. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is
25 constant. Equip hatch with water diverter or cricket on side that obstructs water flow.
- 26 F. Hardware: Spring operators, hold-open arm, spring latch with turn handles, stainless-steel butt- or pintle-type hinge
27 system, and padlock hasps inside and outside.
- 28 1. Provide two-point latch on lids larger than **84 inches (2130 mm)**.
29
- 30 G. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
- 31 1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
32 2. Height: **42 inches (1060 mm)**> above finished roof deck.
33 3. Material: Steel tube.
34 4. Post: **1-5/8-inch- (41-mm-)** diameter pipe.
35 5. Finish: Manufacturer's standard baked enamel or powder coat.
36 a. Color: As selected by Architect from manufacturer's full range.
- 37 2.3 METAL MATERIALS
- 38 A. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, manufacturer's standard alloy for finish required, with temper to
39 suit forming operations and performance required.
- 40 1. Mill Finish: As manufactured.

- 1 B. Aluminum Extrusions and Tubes: **ASTM B 221 (ASTM B 221M)**, manufacturer's standard alloy and temper for type of
2 use, finished to match assembly where used; otherwise mill finished.
- 3 C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
- 4 D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
- 5 E. Steel Tube: ASTM A 500/A 500M, round tube.
- 6 F. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
- 7 G. Steel Pipe: ASTM A 53/A 53M, galvanized.

8 2.4 MISCELLANEOUS MATERIALS

- 9 A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items
10 required by manufacturer for a complete installation.
- 11 B. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.
- 12 C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable
13 to authorities having jurisdiction and complying with AWPAC C2; not less than **1-1/2 inches (38 mm)** thick.
- 14 D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- 15 E. Underlayment:
 - 16 1. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
 - 17 2. Slip Sheet: Building paper, **3 lb/100 sq. ft. (0.16 kg/sq. m)** minimum, rosin sized.
 - 18 3. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being
19 fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable
20 fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
 - 21 4. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
- 22 F. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of
23 foam rubber, sponge neoprene, or cork.
- 24 G. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory
25 manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal
26 joints and remain watertight.
- 27 H. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized;
28 heavy bodied for expansion joints with limited movement.
- 29 I. Asphalt Roofing Cement: ASTM D 4586/D 4586M, asbestos free, of consistency required for application.

30 2.5 GENERAL FINISH REQUIREMENTS

- 31 A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for
32 applying and designating finishes.
- 33 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
34 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
35 installed to minimize contrast.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

- 3 A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other
4 conditions affecting performance of the Work.
- 5 B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- 6 C. Verify dimensions of roof openings for roof accessories.
- 7 D. Proceed with installation only after unsatisfactory conditions have been corrected.

8 3.2 INSTALLATION

- 9 A. General: Install roof accessories according to manufacturer's written instructions.
- 10 1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment,
11 buckling, or tool marks.
- 12 2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
- 13 3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of
14 roof accessories and fit them to substrates.
- 15 4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of
16 fasteners and seals.
- 17 B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each
18 other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent
19 separation as recommended by manufacturer.
- 20 1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with
21 wood, ferrous metal, or cementitious construction.
- 22 2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a
23 course of underlayment and cover with manufacturer's recommended slip sheet.
- 24 3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for
25 waterproof performance.
- 26 C. Roof-Hatch Installation:
- 27 1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
- 28 2. Attach safety railing system to roof-hatch curb.
- 29 3. Attach ladder-assist post according to manufacturer's written instructions.
- 30 D. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

31 3.3 REPAIR AND CLEANING

- 32 A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to
33 ASTM A 780/A 780M.
- 34 B.
- 35 C. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 099113
36 "Exterior Painting."

- 1 D. Clean exposed surfaces according to manufacturer's written instructions.
- 2 E. Clean off excess sealants.
- 3 F. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or
- 4 similar minor repair procedures.

- 5 END OF SECTION 077200

1 SECTION 078413 - PENETRATION FIRESTOPPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Penetrations in fire-resistance-rated walls.

9 1.3 ACTION SUBMITTALS

- 10 A. Product Data: For each type of product.

- 11 B. Sustainable Design Submittals:

- 12 1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside waterproofing system,
13 including printed statement of VOC content.

- 14 C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system,
15 and design designation of qualified testing and inspecting agency.

- 16 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting
17 agency's illustration for a particular penetration firestopping system, submit illustration, with modifications
18 marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an
19 engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having
20 jurisdiction prior to submittal.

21 1.4 INFORMATIONAL SUBMITTALS

- 22 A. Qualification Data: For Installer.

- 23 B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

24 1.5 CLOSEOUT SUBMITTALS

- 25 A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in
26 compliance with requirements and manufacturer's written instructions.

27 1.6 QUALITY ASSURANCE

- 28 A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material,
29 design, and extent to that indicated for this Project, whose work has resulted in construction with a record of

1 successful performance. Qualifications include having the necessary experience, staff, and training to install
2 manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration
3 firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification
4 on buyer.

5 B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint
6 systems in Project to a single qualified installer.

7 C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction
8 condition indicated, through one source from a single manufacturer.

9 1.7 PROJECT CONDITIONS

10 A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures
11 are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because
12 of rain, frost, condensation, or other causes.

13 B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of
14 ventilations or, where this is inadequate, forced-air circulation.

15 1.8 COORDINATION

16 A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be
17 installed according to specified firestopping system design.

18 B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping
19 systems.

20 PART 2 - PRODUCTS

21 2.1 PERFORMANCE REQUIREMENTS

22 A. Fire-Test-Response Characteristics:

23 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having
24 jurisdiction.

25 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems
26 complying with the following requirements:

27 a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

- 28 1) UL in its "Fire Resistance Directory."
- 29 2) Intertek Group in its "Directory of Listed Building Products."
- 30 3) FM Global in its "Building Materials Approval Guide."

31 2.2 PENETRATION FIRESTOPPING SYSTEMS

32 A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and
33 maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be
34 compatible with one another, with the substrates forming openings, and with penetrating items if any.

- 1 1. Products: Subject to compliance with requirements, provide one of the through-penetration firestop
2 systems indicated for each application that are produced by one of the following manufacturers:
3 a. A/D Fire Protection Systems Inc.
4 b. Grace, W. R. & Co. - Conn.
5 c. Hilti, Inc.
6 d. Johns Manville.
7 e. Nelson Firestop Products.
8 f. NUCO Inc.
9 g. RectorSeal Corporation (The).
10 h. Specified Technologies Inc.
11 i. 3M; Fire Protection Products Division.
12 j. Tremco; Sealant/Weatherproofing Division.
13 k. USG Corporation
- 14 B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per
15 ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
- 16 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- 17 C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450,
18 respectively, per ASTM E 84.
- 19 D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials
20 and to maintain ratings required. Use only those components specified by penetration firestopping system
21 manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
- 22 1. Permanent forming/damming/backing materials.

23 PART 3 - EXECUTION

24 3.1 EXAMINATION

- 25 A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening
26 configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- 27 B. Proceed with installation only after unsatisfactory conditions have been corrected.

28 3.2 PREPARATION

- 29 A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply
30 with manufacturer's written instructions and with the following requirements:
- 31 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could
32 interfere with adhesion of penetration firestopping materials.
- 33 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing
34 optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning
35 operation.
- 36 3. Remove laitance and form-release agents from concrete.
- 37 B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended
38 products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed
39 surfaces.

- 1 3.3 INSTALLATION
- 2 A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions
3 and published drawings for products and applications.
- 4 B. Install forming materials and other accessories of types required to support fill materials during their application
5 and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
- 6 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and
7 other accessories not forming permanent components of firestopping.
- 8 C. Install fill materials by proven techniques to produce the following results:
- 9 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve
10 required fire-resistance ratings.
- 11 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
- 12 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform
13 surfaces that are flush with adjoining finishes.

14 3.4 IDENTIFICATION

- 15 A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE
16 AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with
17 minimum 0.375-inch (9.5-mm) strokes.
- 18 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at
19 intervals not exceeding 30 feet (9.14 m).
- 20 B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach
21 labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge
22 so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical
23 fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which
24 labels are placed. Include the following information on labels:
- 25 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any
26 Damage."
- 27 2. Contractor's name, address, and phone number.
- 28 3. Designation of applicable testing and inspecting agency.
- 29 4. Date of installation.
- 30 5. Manufacturer's name.
- 31 6. Installer's name.

32 3.5 CLEANING AND PROTECTION

- 33 A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials
34 that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in
35 which openings occur.
- 36 B. Provide final protection and maintain conditions during and after installation that ensure that penetration
37 firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such
38 protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration
39 firestopping material and install new materials to produce systems complying with specified requirements.

40 END OF SECTION 078413

1 SECTION 078443 - JOINT FIRESTOPPING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Joints in or between fire-resistance-rated constructions.

- 9 B. Related Requirements:

- 10 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls **and for wall**
11 **identification.**

12 1.3 ACTION SUBMITTALS

- 13 A. Product Data: For each type of product.

- 14 B. Sustainable Design Submittals:

- 15 1. Product Data for Credit EQ 4.1: For fire-resistive joint systems, including printed statement of VOC content.

- 16 C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and
17 design designation of qualified testing agency.

- 18 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's
19 illustration for a particular joint firestopping system condition, submit illustration, with modifications
20 marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering
21 judgment or equivalent fire-resistance-rated assembly.

22 1.4 INFORMATIONAL SUBMITTALS

- 23 A. Qualification Data: For Installer.

- 24 B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

25 1.5 CLOSEOUT SUBMITTALS

- 26 A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with
27 requirements and manufacturer's written instructions.

1 1.6 QUALITY ASSURANCE

2 A. Installer Qualifications: A firm experienced in installing through-penetration firestop systems similar in material,
3 design, and extent to that indicated for this Project, whose work has resulted in construction with a record of
4 successful performance. Qualifications include having the necessary experience, staff, and training to install
5 manufacturer's products per specified requirements. Manufacturer's willingness to sell its through-penetration
6 firestop system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification
7 on buyer.

8 B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint
9 systems in Project to a single qualified installer.

10 C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction
11 condition indicated, through one source from a single manufacturer.

12 1.7 PROJECT CONDITIONS

13 A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are
14 outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost,
15 condensation, or other causes.

16 B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of
17 ventilation or, where this is inadequate, forced-air circulation.

18 1.8 COORDINATION

19 A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified
20 firestopping system design.

21 B. Coordinate sizing of joints to accommodate joint firestopping systems.

22 PART 2 - PRODUCTS

23 2.1 PERFORMANCE REQUIREMENTS

24 A. Fire-Test-Response Characteristics:

25 1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having
26 jurisdiction.

27 2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems
28 complying with the following requirements:

29 a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

30 1) UL in its "Fire Resistance Directory."

31 2) Intertek Group in its "Directory of Listed Building Products."

32 2.2 JOINT FIRESTOPPING SYSTEMS

33 A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain
34 original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint

1 firestopping systems shall accommodate building movements without impairing their ability to resist the passage of
2 fire and hot gases.

3 B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined
4 per ASTM E 1966 or UL 2079.

5 1. Products: Subject to compliance with requirements, provide one of the through-penetration firestop
6 systems indicated for each application that are produced by one of the following manufacturers:

- 7 a. A/D Fire Protection Systems Inc.
- 8 b. Grace, W. R. & Co. - Conn.
- 9 c. Hilti, Inc.
- 10 d. Johns Manville.
- 11 e. Nelson Firestop Products.
- 12 f. NUCO Inc.
- 13 g. RectorSeal Corporation (The).
- 14 h. Specified Technologies Inc.
- 15 i. 3M; Fire Protection Products Division.
- 16 j. Tremco; Sealant/Weatherproofing Division.
- 17 k. USG Corporation

18 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or
19 between which it is installed.

20 C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450,
21 respectively, as determined per ASTM E 84.

22 D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are
23 needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint
24 firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

25 PART 3 - EXECUTION

26 3.1 EXAMINATION

27 A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint
28 configurations, substrates, and other conditions affecting performance of the Work.

29 B. Proceed with installation only after unsatisfactory conditions have been corrected.

30 3.2 PREPARATION

31 A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive
32 joint system manufacturer's written instructions and the following requirements:

- 33 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of
34 elastomeric fill materials or compromise fire-resistive rating.
- 35 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with
36 elastomeric fill materials. Remove loose particles remaining from cleaning operation.
- 37 3. Remove laitance and form-release agents from concrete.

38 B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that
39 manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and
40 migration onto exposed surfaces.

1 3.3 INSTALLATION

2 A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and
3 published drawings for products and applications indicated.

4 B. Install forming materials and other accessories of types required to support elastomeric fill materials during their
5 application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings
6 indicated.

7 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming
8 materials and other accessories not indicated as permanent components of fire-resistive joint system.

9 C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following
10 results:

11 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-
12 resistance ratings indicated.

13 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.

14 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth,
15 uniform surfaces that are flush with adjoining finishes.

16 3.4 IDENTIFICATION

17 A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently
18 to surfaces adjacent to and within 6 inches (150 mm) of joint edge so labels are visible to anyone seeking to remove
19 or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of
20 permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

21 1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."

22 2. Contractor's name, address, and phone number.

23 3. Designation of applicable testing agency.

24 4. Date of installation.

25 5. Manufacturer's name.

26 6. Installer's name.

27 3.5 CLEANING AND PROTECTION

28 A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning
29 materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials
30 in which joints occur.

31 B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems
32 are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite
33 such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install
34 new materials to produce fire-resistive joint systems complying with specified requirements.

35 END OF SECTION 078443

1 SECTION 079200 - JOINT SEALANTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Silicone joint sealants.
9 2. Urethane joint sealants.
10 3. Latex joint sealants.
11 4. Acoustical Joint Sealants.
12 5. Smoke Stop Sealants.

13 B. Related Requirements:

- 14
15 1. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
16 2. Division 08 Section "Glazing" for glazing sealants.
17 3. Division 09 Section "Gypsum Board" for sealing perimeter joints.
18 4. Division 09 Section "Tiling" for sealing tile joints.

19 1.3 ACTION SUBMITTALS

- 20 A. Product Data: For each joint-sealant product.

21 B. Sustainable Design Submittals:

- 22 1. Product Data for Credit EQ 4.1: For sealants and sealant primers used inside the weatherproofing system,
23 including printed statement of VOC content.

- 24 C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full
25 range of colors available for each product exposed to view.

- 26 D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in
27 **1/2-inch- (13-mm-)** wide joints formed between two **6-inch- (150-mm-)** long strips of material matching the
28 appearance of exposed surfaces adjacent to joint sealants.

29 E. Joint-Sealant Schedule: Include the following information:

- 30 1. Joint-sealant application, joint location, and designation.
31 2. Joint-sealant manufacturer and product name.
32 3. Joint-sealant formulation.
33 4. Joint-sealant color.

- 1 1.4 INFORMATIONAL SUBMITTALS
- 2 A. Qualification Data: For qualified testing agency and installer.
- 3 B. Product Test Reports: For each kind of joint sealant, for tests performed by a **qualified testing agency**.
- 4 C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate
5 material to be tested:
- 6 1. Joint-sealant location and designation.
- 7 2. Manufacturer and product name.
- 8 3. Type of substrate material.
- 9 4. Proposed test.
- 10 5. Number of samples required.
- 11 D. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in
12 optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- 13 E. Field-Adhesion-Test Reports: For each sealant application tested.
- 14 F. Sample Warranties: For special warranties.
- 15 1.5 QUALITY ASSURANCE
- 16 A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- 17 B. Product Testing: Test joint sealants using a qualified testing agency.
- 18 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- 19 C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint
20 sealants specified in this Section. Use materials and installation methods specified in this Section.
- 21 1.6 PRECONSTRUCTION TESTING
- 22 A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint
23 substrates as follows:
- 24 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
- 25 2. Conduct field tests for each kind of sealant and joint substrate.
- 26 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
- 27 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
- 28 a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab,
29 in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- 30 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend
31 cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
- 32 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance
33 used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until
34 satisfactory adhesion is obtained.
- 35 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from
36 testing, in absence of other indications of noncompliance with requirements, will be considered
37 satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

- 1 1.7 FIELD CONDITIONS
- 2 A. Do not proceed with installation of joint sealants under the following conditions:
- 3 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant
4 manufacturer.
- 5 2. When joint substrates are wet.
- 6 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
- 7 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

8 1.8 WARRANTY

- 9 A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance
10 and other requirements specified in this Section within specified warranty period.
- 11 1. Warranty Period: **Two** years from date of Substantial Completion.
- 12 B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint
13 sealants that do not comply with performance and other requirements specified in this Section within specified
14 warranty period.
- 15 1. Warranty Period: 10 years from date of Substantial Completion.
- 16 C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
- 17 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written
18 specifications for sealant elongation and compression.
- 19 2. Disintegration of joint substrates from causes exceeding design specifications.
- 20 3. Mechanical damage caused by individuals, tools, or other outside agents.
- 21 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

22 PART 2 - PRODUCTS

23 2.1 JOINT SEALANTS, GENERAL

- 24 A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another
25 and with joint substrates under conditions of service and application, as demonstrated by joint-sealant
26 manufacturer, based on testing and field experience.
- 27 B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system
28 that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D
29 (EPA Method 24):
- 30
- 31 1. Architectural Sealants: 250 g/L.
- 32 2. Sealant Primers for Nonporous Substrates: 250 g/L.
- 33 3. Sealant Primers for Porous Substrates: 775 g/L.
- 34 C. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with
35 food, provide products that comply with 21 CFR 177.2600.
- 36 D. Colors of Exposed Joint Sealants: **As selected by Architect from manufacturer's full range.**

- 1 2.2 SILICONE JOINT SEALANTS
- 2 A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for
3 Use NT.
4
- 5 1. Products: Subject to compliance with requirements, provide one of the following:
6 a. Dow Corning Corporation; 790
7 b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
8 c. Tremco Incorporated; Spectrem 1.
- 9 B. Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS,
10 Class 100/50, for Use T.
11
- 12 1. Products: Subject to compliance with requirements, provide one of the following:
13 a. Dow Corning Corporation; 790.
14 b. Pecora Corporation; 301 NS or 311 NS.
15 c. Tremco Incorporated; Spectrem 800.
- 16 C. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25,
17 for Use NT.
18
- 19 1. Products: Subject to compliance with requirements, provide one of the following:
20 a. Dow Corning Corporation; 786 Mildew Resistant.
21 b. GE Advanced Materials - Silicones; Sanitary SCS1700.
22 c. Tremco Incorporated; Tremsil 200 Sanitary.
- 23 2.3 URETHANE JOINT SEALANTS
- 24 A. Multicomponent, Nonsag, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for
25 Use T.
26
- 27 1. Products: Subject to compliance with requirements, provide one of the following:
28 a. BASF Building Systems; Sonolastic NP 2.
29 b. Pecora Corporation; Dynatred.
30 c. Tremco Incorporated; Vulkem 227.
- 31 2.4 LATEX JOINT SEALANTS
- 32 A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
33
- 34 1. Products: Subject to compliance with requirements, provide one of the following:
35 a. BASF Building Systems; Sonolac.
36 b. Pecora Corporation; AC-20+.
37 c. Tremco Incorporated; Tremflex 834.
- 38 2.5 ACOUSTICAL JOINT SEALANTS
- 39 A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with
40 ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in
41 building construction as demonstrated by testing representative assemblies according to ASTM E 90.
42
- 43 1. Products: Subject to compliance with requirements, provide one of the following:
44 a. Pecora Corporation; AC-20 FTR.
45 b. USG Corporation; SHEETROCK Acoustical Sealant.

- 1 2.6 SMOKE STOP JOINT SEALANTS
- 2 A. Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining acrylic latex sealant complying with
3 ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in
4 building construction as demonstrated by testing representative assemblies according to ASTM E 90.
5
- 6 1. Products: Subject to compliance with requirements, provide one of the following:
7 a. Pecora Corporation; AC-20 FTR.
8 b. USG Corporation; SHEETROCK Acoustical Sealant.

9 2.7 JOINT-SEALANT BACKING

- 10 A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint
11 fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory
12 testing.
- 13 B. Cylindrical Sealant Backings: ASTM C 1330, **Type C (closed-cell material with a surface skin) or Type B (bicellular**
14 **material with a surface skin)** and of size and density to control sealant depth and otherwise contribute to
15 producing optimum sealant performance.
- 16 C. Joint subcaulking material should be sized to be under approximately 25% or less compression when in final
17 position, except for joint configurations requiring 1/2 round or 1/4 round rod stock, which should be secured in
18 position with a nonsmear adhesive.
- 19 D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing
20 sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive
21 tape where applicable.

22 2.8 MISCELLANEOUS MATERIALS

- 23 A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint
24 substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- 25 B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing
26 materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent
27 nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- 28 C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

29 PART 3 - EXECUTION

30 3.1 EXAMINATION

- 31 A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint
32 configuration, installation tolerances, and other conditions affecting performance of the Work.
- 33 B. Proceed with installation only after unsatisfactory conditions have been corrected.

34 3.2 PREPARATION

- 35 A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant
36 manufacturer's written instructions and the following requirements:

- 1 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant,
2 including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion
3 and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents,
4 water, surface dirt, and frost.
- 5 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these
6 methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
7 Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with
8 oil-free compressed air. Porous joint substrates include the following:
- 9 a. Concrete.
10 b. Masonry.
11 c. Unglazed surfaces of ceramic tile.
- 12 3. Remove laitance and form-release agents from concrete.
13 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm
14 substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint
15 substrates include the following:
- 16 a. Metal.
17 b. Glass.
18 c. Porcelain enamel.
19 d. Glazed surfaces of ceramic tile.
- 20 B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by
21 preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant
22 manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or
23 migration onto adjoining surfaces.
- 24 C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces
25 that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to
26 remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- 27 3.3 INSTALLATION OF JOINT SEALANTS
- 28 A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications
29 indicated, unless more stringent requirements apply.
- 30 B. Movement joints in clay products masonry should be caulked when dry and temperatures are 70F or above. Other
31 joints may be caulked when surfaces are dry and air temperatures are over 40F.
- 32 C. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable
33 to materials, applications, and conditions indicated.
- 34 D. Depth of sealant at the center of its cross section should be uniform and approximately 1/2 width of sealant, with
35 no depth less than 1/3 the width. Depth of sealant at bond interface should be uniform and approximately equal to
36 width of sealant with no depth less than 3/4 the width, except where a bond breaker is used.
- 37 E. Whenever a caulked joint is required between two surfaces which are at approximately 90° to each other, sealant
38 should be provided with proper backing to obtain the reduced depth of the sealant required at the center of its
39 cross section.
- 40 F. Joints in general should be 3/8" wide unless indicated otherwise on the drawings, with no joint less than 1/4" wide.
- 41 G. Sealant should be interrupted at open head ventilators, weep holes or similar construction where a continuous
42 sealant application would tend to trap water in the wall.

- 1 H. Install sealant backings of kind indicated to support sealants during application and at position required to produce
2 cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant
3 movement capability.
- 4 1. Do not leave gaps between ends of sealant backings.
5 2. Do not stretch, twist, puncture, or tear sealant backings.
6 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them
7 with dry materials.
- 8 I. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of
9 joints.
- 10 J. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
- 11 1. Place sealants so they directly contact and fully wet joint substrates.
12 2. Completely fill recesses in each joint configuration.
13 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant
14 movement capability.
- 15 K. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool
16 sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of
17 configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
- 18 1. Remove excess sealant from surfaces adjacent to joints.
19 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or
20 adjacent surfaces.
21 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
22 4. Provide flush joint profile where **indicated on Drawings** according to Figure 8B in ASTM C 1193.
23 5. Provide recessed joint configuration of recess depth and at **locations indicated on Drawings** according to
24 Figure 8C in ASTM C 1193.
- 25 a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- 26 L. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at
27 perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant.
28 Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with
29 ASTM C 919 and with manufacturer's written recommendations
- 30 3.4 FIELD QUALITY CONTROL
- 31 A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
- 32 1. Extent of Testing: Test completed and cured sealant joints as follows:
- 33 a. Perform **10** tests for the first **1000 feet** of joint length for each kind of sealant and joint substrate.
34 b. Perform one test for each **1000 feet (300 m)** of joint length thereafter or one test per each floor per
35 elevation.
- 36 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in
37 Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- 38 a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along
39 one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
- 40 3. Inspect tested joints and report on the following:

- 1 a. Whether sealants filled joint cavities and are free of voids.
 2 b. Whether sealant dimensions and configurations comply with specified requirements.
 3 c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or
 4 tore cohesively. Include data on pull distance used to test each kind of product and joint substrate.
 5 Compare these results to determine if adhesion complies with sealant manufacturer's field-
 6 adhesion hand-pull test criteria.
- 7 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of
 8 persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and
 9 percent elongations, sealant material, sealant configuration, and sealant dimensions.
- 10 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to
 11 seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- 12 B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance
 13 with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint
 14 substrates during testing or to comply with other requirements. Retest failed applications until test results prove
 15 sealants comply with indicated requirements.
- 16 C. Completed, caulked joints should be neat and watertight with sealant material securely bonded to sides of joints
 17 (interfaces) and unbonded to backing. (Visible gassing or bubbling of sealant material will not be tolerated.)
- 18 3.5 CLEANING
- 19 A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning
 20 materials approved in writing by manufacturers of joint sealants and of products in which joints occur.
- 21 3.6 PROTECTION
- 22 A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage
 23 resulting from construction operations or other causes so sealants are without deterioration or damage at time of
 24 Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair
 25 damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from
 26 original work.
- 27 3.7 JOINT-SEALANT SCHEDULE
- 28 A. Provide the following sealant types to the joint conditions described below including, but not limited to the
 29 following:
 30
- 31 1. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 32 a. Joint Locations:
 33 b. Isolation and contraction joints in cast-in-place concrete slabs.
 34 c. Other porous joints as indicated.
 35
 36 d. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 25.
 37 e. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
 38
- 39 2. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 40 a. Joint Locations:
 41 b. Joints between metal panels.
 42 c. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 43 d. Control and expansion joints in ceilings and other overhead surfaces.
 44 e. Other non-porous joints as indicated.
 45 f. Construction joints in cast-in-place concrete.

- 1 g. Control and expansion joints in unit masonry.
- 2 h. Joints between different materials listed above.
- 3 i. Perimeter joints between materials listed above and frames of doors, windows and louvers.
- 4 j. Other porous joints as indicated.
- 5
- 6 k. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
- 7 l. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors including
- 8 custom colors if deemed appropriate by Architect.
- 9
- 10 3. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
- 11 a. Joint Locations:
- 12 b. Control and expansion joints in tile flooring.
- 13 c. Other non-porous joints as indicated.
- 14 d. Isolation joints in cast-in-place concrete slabs.
- 15 e. Other porous joints as indicated.
- 16
- 17 f. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
- 18 g. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- 19
- 20 4. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
- 21 a. Joint Locations:
- 22 b. Control and expansion joints on exposed interior surfaces of exterior walls.
- 23 c. Perimeter joints of exterior openings where indicated.
- 24 d. Tile control and expansion joints.
- 25 e. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
- 26 f. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator
- 27 entrances.
- 28 g. Other joints as indicated.
- 29
- 30 h. Joint Sealant: Latex.
- 31 i. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- 32
- 33 5. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic
- 34 surfaces.
- 35 a. Joint Sealant Location:
- 36 b. Joints between plumbing fixtures and adjoining walls, floors, and counters.
- 37 c. Tile control and expansion joints where indicated.
- 38 d. Other joints as indicated.
- 39
- 40 e. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
- 41 f. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- 42
- 43 6. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
- 44 a. Joint Location:
- 45 b. Acoustical joints where indicated.
- 46 c. Other joints as indicated.
- 47 d.
- 48 e. Joint Sealant: Acoustical.
- 49 f. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
- 50 B. General Notes:
- 51
- 52 1. For conditions not scheduled, provide manufacturer's recommendations.

53 END OF SECTION 079200

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1 SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section includes:

- 8 1. Interior standard steel doors and frames.
9 2. Exterior standard steel doors and frames.

10 B. Related Requirements:

- 11
12 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

13 1.3 DEFINITIONS

14 A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or
15 SDI A250.8.

16 1.4 COORDINATION

17 A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for
18 installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such
19 items to Project site in time for installation.

20 B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and
21 security systems.

22 1.5 PREINSTALLATION MEETINGS

23 A. Preinstallation Conference: Conduct conference at Project site.

24 1.6 ACTION SUBMITTALS

25 A. Product Data: For each type of product.

26 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

27 B. Sustainable Design Submittals:
28

- 1 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
2 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
3 product having recycled content.
 - 4 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
5 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
6 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
7 material, and fraction by weight that is considered regional.
 - 8 3. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
- 9 C. Shop Drawings: Include the following:
- 10 1. Elevations of each door type.
 - 11 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 12 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 13 4. Locations of reinforcement and preparations for hardware.
 - 14 5. Details of each different wall opening condition.
 - 15 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security
16 systems.
 - 17 7. Details of anchorages, joints, field splices, and connections.
 - 18 8. Details of accessories.
 - 19 9. Details of moldings, removable stops, and glazing.
- 20 D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same
21 reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

22 1.7 INFORMATIONAL SUBMITTALS

- 23 A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified
24 testing agency.

25 1.8 DELIVERY, STORAGE, AND HANDLING

- 26 A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and
27 Project-site storage. Do not use nonvented plastic.
- 28 1. Provide additional protection to prevent damage to factory-finished units.
- 29 B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and
30 mullions.
- 31 C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-
32 (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air
33 circulation.

34 PART 2 - PRODUCTS

35 2.1 MANUFACTURERS

- 36 A. Subject to compliance with requirements, [available manufacturers offering products that may be incorporated into
37 the Work include, but are not limited to, the following:
- 38
- 39 1. Amweld Building Products, LLC.
 - 40 2. Benchmark; a division of Therma-Tru Corporation.

- 1 3. Ceco Door Products; an Assa Abloy Group company.
- 2 4. Curries Company; an Assa Abloy Group company.
- 3 5. Deansteel Manufacturing Company, Inc.
- 4 6. Firedoor Corporation.
- 5 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
- 6 8. Habersham Metal Products Company.
- 7 9. Kewanee Corporation (The).
- 8 10. Mesker Door Inc.
- 9 11. Pioneer Industries, Inc.
- 10 12. Security Metal Products Corp.
- 11 13. Steelcraft; an Ingersoll-Rand company.
- 12 14. Windsor Republic Doors.

13 2.2 PERFORMANCE REQUIREMENTS

- 14 A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to
- 15 authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according
- 16 to NFPA 252 or UL 10C.
- 17 B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency
- 18 acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to
- 19 NFPA 257 or UL 9.
- 20 C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.38 deg Btu/F x h x sq.
- 21 ft. (2.16 W/K x sq. m) when tested according to ASTM C 518.

22 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- 23 A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware
- 24 locations, hardware reinforcement, tolerances, and clearances, and as specified.
- 25 B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B.
- 26 1. Doors:
- 27 a. Type: As indicated in the Door and Frame Schedule.
- 28 b. Thickness: 1-3/4 inches (44.5 mm).
- 29 c. Face: Uncoated (unless metallic-coated is indicated) steel sheet, minimum thickness of 0.042 inch
- 30 (1.0 mm).
- 31 d. Edge Construction: Model 1, Full Flush.
- 32 e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
- 33 f. Core: Manufacturer's standard.
- 34 g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.
- 35 2. Frames:
- 36 a. Materials: Uncoated (unless metallic-coated is indicated) steel sheet, minimum thickness of 0.053
- 37 inch (1.3 mm).
- 38 b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
- 39 c. Construction: Face welded.
- 40 3. Exposed Finish: Prime.

- 1 2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES
- 2 A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware
3 locations, hardware reinforcement, tolerances, and clearances, and as specified.
- 4 B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A..
- 5 1. Doors:
- 6 a. Type: As indicated in the Door and Frame Schedule.
7 b. Thickness: 1-3/4 inches (44.5 mm).
8 c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40
9 (ZF120) coating.
10 d. Edge Construction: Model 1, Full Flush.
11 e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
12 f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
13 Seal joints against water penetration.
14 g. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face
15 sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
16 h. Core: Manufacturer's standard.
- 17 2. Frames:
- 18 a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum
19 A40 (ZF120) coating.
20 b. Construction: Full profile welded.
- 21 3. Exposed Finish: Prime.
- 22 2.5 BORROWED LITES
- 23 A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- 24 B. Construction: Full profile welded.
- 25 C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are
26 fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint,
27 fabricated of metal of same or greater thickness as metal as frames.
- 28 D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
- 29 2.6 HOLLOW-METAL PANELS
- 30 A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.
- 31 2.7 FRAME ANCHORS
- 32 A. Jamb Anchors:
- 33 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for
34 performance level indicated.
35 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor.
36 Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).

1 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or
2 inserts, with manufacturer's standard pipe spacer.

3 B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

4 C. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

5 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or
6 ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

7 2.8 MATERIALS

8 A. Recycled Content of steel doors and frame Products: Postconsumer recycled content plus one-half of preconsumer
9 recycled content not less than 35 percent

10 B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

11 C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface
12 defects; pickled and oiled.

13 D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

14 E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

15 F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from
16 corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type
17 indicated.

18 G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers
19 manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50,
20 respectively; passing ASTM E 136 for combustion characteristics.

21 H. Glazing: Comply with requirements in Section 088000 "Glazing."

22 2.9 FABRICATION

23 A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-
24 performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal
25 is mounted or as required to comply with published listing of qualified testing agency.

26 B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple
27 sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of
28 metal of same or greater thickness as frames.

29 1. Sidelite Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same
30 material as door frame. Fasten members at crossings and to jambs by welding.

31 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise
32 indicated.

33 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep
34 holes clear during construction.

35 a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

36 b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- 1 4. Terminated Stops: Terminate stops 6 inches (152 mm) above finish floor with a 45-degree angle cut, and
2 close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler
3 plate, with welds ground smooth and flush with frame.
- 4 C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware,
5 and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the
6 Door Hardware Schedule, and templates.
- 7 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
8 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- 9 D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings
10 with mitered hairline joints.
- 11 1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
12 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of
13 being removed independently.
14 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide
15 loose stops and moldings on inside of hollow-metal doors and frames.
16 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
17 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not
18 more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.
- 19 2.10 STEEL FINISHES
- 20 A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
- 21 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with
22 SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-
23 applied coatings despite prolonged exposure.
- 24 PART 3 - EXECUTION
- 25 3.1 PREPARATION
- 26 A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing,
27 as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes
28 where spreaders are removed.
- 29 B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
- 30 3.2 INSTALLATION
- 31 A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place.
32 Comply with approved Shop Drawings and with manufacturer's written instructions.
- 33 B. Hollow-Metal Frames: Comply with SDI A250.11.
- 34 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set.
35 After wall construction is complete, remove temporary braces without damage to completed Work.

- 1 a. Where frames are fabricated in sections, field splice at approved locations by welding face joint
2 continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-
3 up finishes.
- 4 b. Install frames with removable stops located on secure side of opening.
- 5 2. Fire-Rated Openings: Install frames according to NFPA 80.
- 6 3. Floor Anchors: Secure with postinstalled expansion anchors.
- 7 4. Solidly pack mineral-fiber insulation inside frames.
- 8 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and
9 masonry with grout or mortar.
- 10 6. In-Place Concrete: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and
11 fill and make smooth, flush, and invisible on exposed faces.
- 12 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
- 13 a. Squareness: Plus or minus **1/16 inch (1.6 mm)**, measured at door rabbet on a line 90 degrees from
14 jamb perpendicular to frame head.
- 15 b. Alignment: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs on a horizontal line parallel to
16 plane of wall.
- 17 c. Twist: Plus or minus **1/16 inch (1.6 mm)**, measured at opposite face corners of jambs on parallel
18 lines, and perpendicular to plane of wall.
- 19 d. Plumbness: Plus or minus **1/16 inch (1.6 mm)**, measured at jambs at floor.
- 20 C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
- 21 1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
- 22 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- 23 D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's
24 written instructions.
- 25 3.3 CLEANING AND TOUCHUP
- 26 A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply
27 touchup of compatible air-drying, rust-inhibitive primer.
- 28 B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to
29 manufacturer's written instructions.
- 30 C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.
- 31 END OF SECTION 081113

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1 SECTION 081416 - FLUSH WOOD DOORS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Solid-core doors with wood-veneer faces.
9 2. Factory finishing flush wood doors.
10 3. Bullet-resistant wood door.
11 4. Factory fitting flush wood doors to frames and factory machining for hardware.

12 B. Related Requirements:

- 13 1. Section 088000 "Glazing" for glass view panels in flush wood doors.
14

15 1.3 PREINSTALLATION MEETINGS

- 16 A. Preinstallation Conference: Conduct conference at Project site.

17 1.4 ACTION SUBMITTALS

- 18 A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include
19 factory-finishing specifications.

20 B. Sustainable Design Submittals:

- 21 1. Product Certificates for Credit EQ 4.1: Product data for adhesives and sealants, including printed statement
22 of VOC content.
23 2. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that
24 product contains no urea formaldehyde.
25 3. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
26 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
27 product having recycled content.
28 4. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
29 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
30 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
31 material, and fraction by weight that is considered regional.
32

- 33 C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details
34 not covered in Product Data; and the following:

- 35 1. Dimensions and locations of blocking.
36 2. Dimensions and locations of mortises and holes for hardware.
37 3. Dimensions and locations of cutouts.

- 1 4. Undercuts.
2 5. Requirements for veneer matching.
3 6. Doors to be factory finished and finish requirements.
4 7. Fire-protection ratings for fire-rated doors.
- 5 D. Samples for Initial Selection: For factory-finished doors.
- 6 E. Samples for Verification:
- 7 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for
8 each material and finish. For each wood species and transparent finish, provide set of three Samples
9 showing typical range of color and grain to be expected in finished Work.
10 2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.
- 11 1.5 INFORMATIONAL SUBMITTALS
- 12 A. Sample Warranty: For special warranty.
- 13 B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.
- 14 1.6 QUALITY ASSURANCE
- 15 A. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality
16 Standards Illustrated.
17
- 18 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors
19 comply with requirements of grades specified.
- 20 B. Underwriters Laboratories (UL)52 - Bullet Resisting Equipment.
- 21 C. Provide door and frame assemblies of "non-ricochet type" intended to permit capture and retention of attacking
22 projectile, lessening potential of random injury or lateral penetration.
- 23 D. Door and Frame Assemblies: Ballistic Level 3, tested to UL 752.
- 24 1.7 DELIVERY, STORAGE, AND HANDLING
- 25 A. Comply with requirements of referenced standard and manufacturer's written instructions.
- 26 B. Package doors individually in plastic bags or cardboard cartons.
- 27 C. Mark each door on top and bottom rail with opening number used on Shop Drawings.
- 28 1.8 FIELD CONDITIONS
- 29 A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in
30 spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F
31 (16 and 32 deg C) and relative humidity between 25 and 55 percent during remainder of construction period.

- 1 1.9 WARRANTY
- 2 A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within
3 specified warranty period.
- 4 1. Failures include, but are not limited to, the following:
- 5 a. Warping (bow, cup, or twist) more than 1/4 inch (6.4 mm) in a 42-by-84-inch (1067-by-2134-mm)
6 section.
- 7 b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch (0.25 mm in a
8 76.2-mm) span.
- 9 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of
10 defective doors.
- 11 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

12 PART 2 - PRODUCTS

13 2.1 MANUFACTURERS

- 14 A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into
15 the Work include, but are not limited to, the following:
- 16
- 17 1. Algoma Hardwoods, Inc.
- 18 2. Ampco, Inc.
- 19 3. ARMORTEX
- 20 4. Buell Door Company Inc.
- 21 5. Chappell Door Co.
- 22 6. Eagle Plywood & Door Manufacturing, Inc.
- 23 7. Eggers Industries.
- 24 8. Graham; an Assa Abloy Group company.
- 25 9. Haley Brothers, Inc.
- 26 10. Ideal Architectural Doors & Plywood.
- 27 11. Ipiq Door Company.
- 28 12. Lambton Doors.
- 29 13. Marlite.
- 30 14. Marshfield Door Systems, Inc.
- 31 15. Mohawk Flush Doors, Inc.; a Masonite company.
- 32 16. Oshkosh Architectural Door Company.
- 33 17. Poncraft Door Company.
- 34 18. Vancouver Door Company.
- 35 19. VT Industries Inc

- 36 B. Source Limitations: Obtain flush wood doors from single manufacturer.

37 2.2 FLUSH WOOD DOORS, GENERAL

- 38 A. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for
39 fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- 40 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
- 41 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with
42 specified requirements for exposed edges.

1 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel
2 edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements
3 for exposed edges.

4 B. Structural-Composite-Lumber-Core Doors:

5 1. Structural Composite Lumber: WDMA I.S.10.

6 a. Screw Withdrawal, Face: 700 lbf (3100 N).

7 b. Screw Withdrawal, Edge: 400 lbf (1780 N).

8 C. Mineral-Core Doors:

9 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and
10 testing and inspecting agency for fire-protection rating indicated.

11 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of
12 fire-protection ratings indicated as needed to eliminate through-bolting hardware.

13 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding
14 capability and split resistance. Comply with specified requirements for exposed edges.

15 a. Screw-Holding Capability: 475 lbf (2110 N) per WDMA T.M.-10.

16 2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

17 A. Interior Solid-Core Doors:

18 1. Grade: Premium, with Grade A faces.

19 2. Species: Select white birch.

20 3. Cut: Plain sliced (flat sliced).

21 4. Match between Veneer Leaves: Book match.

22 5. Assembly of Veneer Leaves on Door Faces: Center-balance match.

23 6. Pair and Set Match: Provide for doors hung in same opening.

24 7. Core: Structural composite lumber.

25 8. Construction: Five or seven plies. Stiles and rails are bonded to core, then entire unit is abrasive planed
26 before veneering. Faces are bonded to core using a hot press.

27 2.4 LIGHT FRAMES AND LOUVERS

28 A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise
29 indicated.

30 1. Wood Species: Same species as door faces.

31 2. Profile: Flush rectangular beads.

32 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips
33 approved for such use.

34 B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered
35 noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection
36 rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating
37 indicated.

- 1 2.5 FABRICATION
- 2 A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality
3 standard for fitting unless otherwise indicated.
- 4 1. Comply with NFPA 80 requirements for fire-rated doors.
- 5 B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3.
6 Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
- 7 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory
8 machining.
- 9 C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as
10 specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door
11 stiles.
- 12 D. Openings: Factory cut and trim openings through doors.
- 13 1. Light Openings: Trim openings with moldings of material and profile indicated.
14 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable
15 requirements in Section 088000 "Glazing."
- 16 E. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors
17 for openings and machining for hardware that is not surface applied, before finishing.
- 18 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom
19 edges, edges of cutouts, and mortises.
- 20 F. Factory finish doors.
- 21 G. Transparent Finish:
- 22 1. Grade: Premium.
23 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
24 3. Staining: As selected by Architect from manufacturer's full range.
25 4. Sheen: Satin.

26 PART 3 - EXECUTION

27 3.1 EXAMINATION

- 28 A. Examine doors and installed door frames, with Installer present, before hanging doors.
- 29 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing
30 characteristics and have been installed with level heads and plumb jambs.
31 2. Reject doors with defects.
- 32 B. Proceed with installation only after unsatisfactory conditions have been corrected.

33 3.2 INSTALLATION

- 34 A. Hardware: For installation, see Section 087100 "Door Hardware."

- 1 B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality
- 2 standard, and as indicated.

- 3 1. Install fire-rated doors according to NFPA 80.

- 4 C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

- 5 D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

- 6 3.3 ADJUSTING

- 7 A. Operation: Rehang or replace doors that do not swing or operate freely.

- 8 B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired
- 9 or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

- 10 END OF SECTION 081416

1 SECTION 083113 - ACCESS DOORS AND FRAMES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes access doors and frames for walls and ceilings.

- 8 B. Related Requirements:

- 9 1. Section 077200 "Roof Accessories" for roof hatches.

10 1.3 ACTION SUBMITTALS

- 11 A. Product Data: For each type of product.

- 12 1. Include construction details material descriptions, dimensions of individual components and profiles, and
13 finishes.

- 14 B. Sustainable Design Requirements

- 15 1. Product Data for Credit M5: For products having recycled content, documentation indicating percentages
16 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
17 product having recycled content.

- 18 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
19 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
20 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
21 material, and fraction by weight that is considered regional.

- 22 C. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6
23 inches (150 by 150 mm) in size.

- 24 D. Product Schedule: For access doors and frames.

25 1.4 COORDINATION

- 26 A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing,
27 mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

1 PART 2 - PRODUCTS

2 2.1 PERFORMANCE REQUIREMENTS

3 A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified
4 testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

5 2.2 ACCESS DOORS AND FRAMES

6 A. Flush Access Doors with Concealed Flanges for installation in gypsum board installations.

7 1. Subject to compliance with requirements, manufacturers offering products that may be incorporated into
8 the Work include, but are not limited to, the following:

- 9 a. Acudor Products, Inc.
- 10 b. Babcock-Davis; A Cierra Products Co.
- 11 c. Bar-Co, Inc. Div.; Alfab, Inc.
- 12 d. Cendrex Inc.
- 13 e. Dur-Red Products.
- 14 f. Elmdor/Stoneman; Div. of Acorn Engineering Co.
- 15 g. Jensen Industries.
- 16 h. J. L. Industries, Inc.
- 17 i. Karp Associates, Inc.
- 18 j. Larsen's Manufacturing Company.
- 19 k. MIFAB, Inc.
- 20 l. Milcor Inc.
- 21 m. Nystrom, Inc.
- 22 n. Williams Bros. Corporation of America (The).

23
24 2. Description: Face of door flush with frame; with concealed flange for **gypsum board** installation and
25 concealed hinge.

26 3. Locations: **Wall and ceiling.**

27 4. Steel Sheet for Door: **Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.**

28 5. Frame Material: **Same material and thickness as door.**

29 6. Latch and Lock: **Cam latch, screwdriver operated.**

30 2.3 MATERIALS

31 A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

32 B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate
33 complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

34 C. Frame Anchors: Same material as door face.

35 D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

36 2.4 FABRICATION

37 A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

38 B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat
39 surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade
40 names, or roughness.

- 1 C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes,
2 attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- 3 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to
4 perimeter of frames.
- 5 D. Latch and Lock Hardware:
- 6 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
7 2. Keys: Furnish two keys per lock and key all locks alike.
- 8 2.5 FINISHES
- 9 A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for
10 applying and designating finishes.
- 11 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
12 covering before shipping.
- 13 C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
14 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
15 installed to minimize contrast.
- 16 D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and
17 applying and baking finish.
- 18 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately
19 after surface preparation and pretreatment.

20 PART 3 - EXECUTION

21 3.1 EXAMINATION

- 22 A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting
23 performance of the Work.
- 24 B. Proceed with installation only after unsatisfactory conditions have been corrected.

25 3.2 INSTALLATION

- 26 A. Comply with manufacturer's written instructions for installing access doors and frames.

27 3.3 ADJUSTING

- 28 A. Adjust doors and hardware, after installation, for proper operation.

29 END OF SECTION 083113

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1 SECTION 083613 - SECTIONAL DOORS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

4 A.

5 B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
6 Specification Sections, apply to this Section.

7 1.2 SUMMARY

8 A. Section includes **electrically** operated sectional doors.

9 B. Related Requirements:

10 1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

11 1.3 ACTION SUBMITTALS

12 A. Product Data: For each type and size of sectional door and accessory.

13 1. Include construction details, material descriptions, dimensions of individual components, profile door
14 sections, and finishes.

15 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

16 B. Sustainable Design submittals:

17
18 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
19 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
20 product having recycled content.

21 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
22 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
23 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
24 material, and fraction by weight that is considered regional.

25 C. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's
26 product data.

27 1. Include plans, elevations, sections, and mounting details.

28 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field
29 assembly, components, and location and size of each field connection.

30 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.

31 4. Include diagrams for power, signal, and control wiring.

32 D. Samples for Initial Selection: For units with factory-applied finishes.

33 1. Include Samples of accessories involving color selection.

- 1 1.4 INFORMATIONAL SUBMITTALS
- 2 A. Qualification Data: For Installer.
- 3 B. Sample Warranties: For special warranties.
- 4 1.5 CLOSEOUT SUBMITTALS
- 5 A. Maintenance Data: For sectional doors to include in maintenance manuals.
- 6 1.6 QUALITY ASSURANCE
- 7 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
8 manufacturer for both installation and maintenance of units required for this Project.
- 9 B. Regulatory Requirements: Comply with applicable provisions in **the U.S. Architectural & Transportation Barriers
10 Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.**
- 11 1.7 WARRANTY
- 12 A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or
13 workmanship within specified warranty period.
- 14 1. Failures include, but are not limited to, the following:
- 15 a. Structural failures including, but not limited to, excessive deflection.
- 16 b. Failure of components or operators before reaching required number of operation cycles.
- 17 c. Faulty operation of hardware.
- 18 d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use;
19 rust through.
- 20 e. Delamination of exterior or interior facing materials.
- 21 2. Warranty Period: **Three** years from date of Substantial Completion.
- 22 PART 2 - PRODUCTS
- 23 2.1 MANUFACTURERS, GENERAL
- 24 A. Source Limitations: Obtain sectional doors from single source from single manufacturer.
- 25 1. Obtain operators and controls from sectional door manufacturer.
- 26 2.2 PERFORMANCE REQUIREMENTS
- 27 A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to
28 defective manufacture, fabrication, installation, or other defects in construction.
- 29 B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
- 30 1. Design Wind Load: **As indicated on Drawings.**

- 1 2. Testing: According to ASTM E 330 or **DASMA 108 for garage doors and complying with the acceptance**
 2 **criteria of DASMA 108.**
- 3 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent
 4 deformation or disengagement of door components.
- 5 a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of the door width.
 6 b. Deflection of horizontal track assembly shall not exceed 1/240 of the door height.
- 7 4. Operability under Wind Load: Design overhead coiling doors to remain operable under **design** wind load,
 8 acting inward and outward.

9 2.3 DOOR ASSEMBLY

10 A. **Steel** Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless
 11 otherwise indicated.

- 12 1. Subject to compliance with requirements, provide Overhead Door Corporation, 599 Series Thermacore
 13 insulated steel door or comparable product from but not limited to the following:
- 14 a. Amarr Garage Doors.
 15 b. Arm-R-Lite.
 16 c. C.H.I. Overhead Doors.
 17 d. Clipay Building Products; a Griffon company.
 18 e. Fimbel Architectural Door Specialties.
 19 f. General American Door Company.
 20 g. Haas Door; a Nofziger company.
 21 h. Martin Door Manufacturing.
 22 i. Raynor.
 23 j. Rite-Hite Corporation.
 24 k. Wayne-Dalton Corp.
 25 l. Windsor Republic Doors

26 B. Operation Cycles: Door components and operators capable of operating for not less than **100,000 (provide high-**
 27 **usage package)**. One operation cycle is complete when a door is opened from the closed position to the fully open
 28 position and returned to the closed position.

29 C. Air Infiltration: Maximum rate of **0.08 cfm/sq. ft.** at **15 and 25 mph (24.1 and 40.2 km/h)** when tested according to
 30 **DASMA 105.**

31 D. **Installed R-Value: 17.5 deg F x h x sq. ft./Btu (3.082 K x sq. m/W).**

32 E. Steel Sections: Zinc-coated (galvanized) steel sheet with zinc coating.

- 33 1. Section Thickness: **2 inches (51 mm).**
 34 2. Exterior-Face, Steel Sheet Thickness: **0.015-inch- (0.38-mm-)** nominal coated thickness.

35 a. Surface: Manufacturer's standard flush.

- 36 3. Insulation: **Board or Foamed in place to meet required R-value.**
 37 4. Interior Facing Material: Zinc-coated (galvanized) steel sheet with a nominal coated thickness of
 38 **manufacturer's recommended dimension to comply with performance requirements.**

39 F. Track Configuration: **Low-headroom track** with front springs.

40 G. Weatherseals: Fitted to bottom and top **and around entire perimeter** of door.

41 H. Roller-Tire Material: **Manufacturer's standard.**

- 1 I. Locking Devices: Equip door with **slide bolt for padlock**.
- 2 J. Counterbalance Type: **Torsion spring**.
- 3 K. Electric Door Operator:
- 4 1. Usage Classification: **Heavy duty, 25 or more cycles per hour and more than 90 cycles per day**.
- 5 2. Operator Type: **Trolley**.
- 6 3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; **moving**
- 7 **parts of operator enclosed or guarded if exposed and mounted at 8 feet (2.4 m) or lower**.
- 8 4. Motor Exposure: **Interior, clean, and dry**.
- 9 5. Emergency Manual Operation: Push-up type.
- 10 6. Obstruction-Detection Device: Automatic **photoelectric sensor**.
- 11 7. Control Station: **Interior-side mounted**.
- 12 L. Door Finish:
- 13
- 14 1. Baked-Enamel or Powder-Coat Finish: **Finish as selected by Architect from manufacturer's full range**
- 15 **including custom colors**
- 16 2. Finish of Interior Facing Material: **Finish as selected by Architect from manufacturer's full range**.
- 17 2.4 MATERIALS, GENERAL
- 18 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing
- 19 agency, and marked for intended location and application.
- 20 2.5 STEEL DOOR SECTIONS
- 21 A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying
- 22 with ASTM A 653/A 653M, with indicated zinc coating and thickness.
- 23 1. Fabricate section faces from single sheets to provide sections not more than **24 inches (610 mm)** high and of
- 24 indicated thickness. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or
- 25 tongue-in-groove weather-resistant seal, with a reinforcing flange return.
- 26 2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior
- 27 and interior faces of door.
- 28 B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from
- 29 galvanized-steel sheet not less than **0.064-inch- (1.63-mm-)** nominal coated thickness and welded to door section.
- 30 Provide intermediate stiles formed from not less than **0.064-inch- (1.63-mm-)** thick galvanized-steel sheet, cut to
- 31 door section profile, and welded in place. Space stiles not more than **48 inches (1219 mm)** apart.
- 32 C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile.
- 33 D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind
- 34 loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.
- 35 E. Provide reinforcement for hardware attachment.
- 36 F. Board Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard **CFC-free**
- 37 polystyrene or polyurethane board insulation, with maximum flame-spread and smoke-developed indexes of 75
- 38 and 450, respectively, according to ASTM E 84; or with glass-fiber-board insulation. Secure insulation to exterior
- 39 face sheet. Enclose insulation completely within steel sections and the interior facing material, with no exposed
- 40 insulation.

- 1 G. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard **CFC-free**
2 polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to
3 prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and
4 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections and the interior
5 facing material, with no exposed insulation.
- 6 H. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with
7 ASTM A 653/A 653M, with indicated thickness.
- 8 I. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist,
9 and deformation.

10 2.6 TRACKS, SUPPORTS, AND ACCESSORIES

- 11 A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and
12 weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including
13 brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type,
14 size, weight, and loading.
 - 15 1. Galvanized Steel: ASTM A 653/A 653M, minimum **G60 (Z180)** zinc coating.
 - 16 2. Slope tracks at an angle from vertical or design tracks to ensure tight closure at jambs when door unit is
17 closed.
 - 18 3. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and
19 vibration during opening and closing of doors. Slot vertical sections of track spaced **2 inches (51 mm)** apart
20 for door-drop safety device.
 - 21 a. For Vertical Track: **Intermittent, jamb brackets attached to track and attached to wall.**
 - 22 b. For Horizontal Track: Continuous reinforcing angle from curve in track to end of track, attached to
23 track and supported at points by laterally braced attachments to overhead structural members.

- 24 B. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber,
25 or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

26 2.7 HARDWARE

- 27 A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-
28 resistant fasteners, to suit door type.
- 29 B. Hinges: Heavy-duty, galvanized-steel hinges of not less than **0.079-inch- (2.01-mm-)** nominal coated thickness at
30 each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size.
31 Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets
32 or self-tapping fasteners where access to nuts is impossible. Provide double-end hinges where required, for doors
33 more than **16 feet (4.88 m)** wide unless otherwise recommended by door manufacturer.
- 34 C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections
35 to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide **3-inch-**
36 **(76-mm-)** diameter roller tires for **3-inch- (76-mm-)** wide track and **2-inch- (51-mm-)** diameter roller tires for **2-inch-**
37 **(51-mm-)** wide track.
- 38 D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles
39 on each side of door, finished to match door.

- 1 2.8 LOCKING DEVICES
- 2 A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on
3 single-jamb side, operable from inside only.
- 4 2.9 COUNTERBALANCE MECHANISM
- 5 A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-
6 spring wire complying with ASTM A 229/A 229M, mounted on torsion shaft made of steel tube or solid steel.
7 Provide springs designed for number of operation cycles indicated.
- 8 B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and
9 grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's
10 standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to
11 **16 feet (4.88 m)** long and two additional brackets at one-third points to support shafts more than **16 feet (4.88 m)**
12 long unless closer spacing is recommended by door manufacturer.
- 13 C. Cables: Galvanized-steel, multistrand, lifting cables **with cable safety factor of at least 7 to 1.**
- 14 D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller
15 assembly on each side and designed to automatically stop door if either lifting cable breaks.
- 16 E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the
17 shaft and prevent sag.
- 18 F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- 19 2.10 ELECTRIC DOOR OPERATORS
- 20 A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for
21 door and "operation cycles" requirement specified, with electric motor and factory-rewired motor controls,
22 starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for
23 locking door, and accessories required for proper operation.
24
- 25 1. Comply with NFPA 70.
26 2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control
27 circuit, maximum 24-V ac or dc.
- 28 B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per
29 hour indicated for each door. Bottom of operator to be no lower than sectional door opening in exterior wall.
- 30 C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed
31 to operate door and meet required usage classification.
- 32 1. Trolley: Trolley operator mounted to ceiling above and to rear of door in raised position and directly
33 connected to door with drawbar.
- 34 D. Motors: Reversible-type motor for motor exposure indicated.
- 35 1. Electrical Characteristics:
- 36 a. Phase: Three phase.
37 b. Volts: **460 V.**
38 c. Hertz: 60.

- 1 2. Motor Size: Large enough to start, accelerate, and operate door in either direction from any position, at a
2 speed not less than **8 in./sec. (203 mm/s)** and not more than **12 in./sec. (305 mm/s)**, without exceeding
3 nameplate ratings or service factor.
- 4 3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard
5 unless otherwise indicated.
- 6 4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with
7 building electrical system and each location where installed.
- 8 5. Use adjustable motor-mounting bases for belt-driven operators.

- 9 E. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to
10 automatically stop door at fully opened and fully closed positions.

- 11 F. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor
12 capable of protecting full width of door opening. Activation of device immediately stops and reverses downward
13 door travel.

- 14 1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening
15 without contact between door and obstruction.

- 16 a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to
17 or disconnection of sensing device. When self-monitoring feature is activated, door closes only with
18 sustained pressure on close button.

- 19 G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls
20 labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."

- 21 1. Each sectional door will have an interior mounted control station.
- 22 2. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose
23 NEMA ICS 6, Type 1 enclosure.

- 24 H. Control Station (exterior entry): Operation of door is controlled via a Nedap Identification System. System provided
25 by others but control interface / door operation included in sectional door scope.

- 26 I. Control Station (interior exit):
27
28 1. Operation of Sallyport sectional doors is via the three-button control.
- 29 2. Operation of lower level parking section door is via an infrared beam when broken via an automobile will
30 open the sectional door.

- 31 J. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation.
32 Design manual mechanism so required force for door operation does not exceed **25 lbf (111 N)**.

- 33 K. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for
34 automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting
35 motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include
36 interlock device to automatically prevent motor from operating when emergency operator is engaged.

- 37 L. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without
38 affecting emergency manual operation.

- 39 2.11 GENERAL FINISH REQUIREMENTS

- 40 A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for
41 recommendations for applying and designating finishes.

1 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
2 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
3 installed to minimize contrast.

4 2.12 STEEL AND GALVANIZED-STEEL FINISHES

5 A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating
6 manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

7 B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and
8 thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment,
9 application, and minimum dry film thickness.

10 PART 3 - EXECUTION

11 3.1 EXAMINATION

12 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate
13 construction and other conditions affecting performance of the Work.

14 B. Examine locations of electrical connections.

15 C. Proceed with installation only after unsatisfactory conditions have been corrected.

16 3.2 INSTALLATION

17 A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and
18 equipment supports; according to manufacturer's written instructions and as specified.

19 B. Tracks:

20 1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches (610 mm)
21 apart.

22 2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached
23 to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as
24 required for rigid installation of track and door-operating equipment.

25 C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory
26 requirements for accessibility.

27 D. Power-Operated Doors: Install according to UL 325.

28 3.3 STARTUP SERVICES

29 A. Engage a factory-authorized service representative to perform startup service.

30 1. Complete installation and startup checks according to manufacturer's written instructions.

31 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

- 1 3.4 ADJUSTING
- 2 A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or
3 distortion.
- 4 B. Lubricate bearings and sliding parts as recommended by manufacturer.
- 5 C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- 6 D. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces
7 and repair galvanizing to comply with ASTM A 780/A 780M.
- 8 3.5 DEMONSTRATION
- 9 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and
10 maintain sectional doors.
- 11 END OF SECTION 083613

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1 SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Storefront framing.
9 2. Manual-swing entrance doors.

10 1.3 PREINSTALLATION MEETINGS

- 11 A. Preinstallation Conference: Conduct conference at Project site.

12 1.4 ACTION SUBMITTALS

- 13 A. Product Data: For each type of product.

- 14 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
15 finishes.

- 16 B. Sustainable Design Submittals:

- 17
18 1. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system,
19 including printed statement of VOC content.
20 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
21 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
22 product having recycled content.
23 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
24 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
25 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
26 material, and fraction by weight that is considered regional.

- 27 C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size
28 details, and attachments to other work.

- 29 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring
30 within the assembly to the exterior.
31 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed
32 entrances and storefronts, showing the following:

- 33 a. Joinery, including concealed welds.
34 b. Anchorage.
35 c. Expansion provisions.
36 d. Glazing.

- 1 e. Flashing and drainage.
- 2 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- 3 4. Include point-to-point wiring diagrams showing the following:
- 4 a. Power requirements for each electrically operated door hardware.
- 5 b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- 6 D. Samples for Initial Selection: For units with factory-applied color finishes.
- 7 E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly
- 8 of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule
- 9 with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door
- 10 hardware.
- 11 1.5 INFORMATIONAL SUBMITTALS
- 12 A. Qualification Data: For Installer.
- 13 B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components,
- 14 from manufacturer.
- 15 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and
- 16 storefront.
- 17 C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing
- 18 agency.
- 19 D. Source quality-control reports.
- 20 E. Sample Warranties: For special warranties.
- 21 1.6 CLOSEOUT SUBMITTALS
- 22 A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.
- 23 1.7 QUALITY ASSURANCE
- 24 A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by
- 25 manufacturer.
- 26 B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and
- 27 performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment,
- 28 and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining
- 29 construction.
- 30 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If
- 31 changes are proposed, submit comprehensive explanatory data to Architect for review.

- 1 1.8 WARRANTY
- 2 A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts
3 that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
- 4 1. Failures include, but are not limited to, the following:
- 5 a. Structural failures, including, but not limited to, excessive deflection.
6 b. Noise or vibration created by wind and thermal and structural movements.
7 c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
8 d. Water penetration through fixed glazing and framing areas.
9 e. Failure of operating components.
- 10 2. Warranty Period: Two years from date of Substantial Completion.
- 11 B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that
12 shows evidence of deterioration of factory-applied finishes within specified warranty period.

13 PART 2 - PRODUCTS

14 2.1 MANUFACTURERS

- 15 A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing
16 and accessories, from single manufacturer.

17 2.2 PERFORMANCE REQUIREMENTS

- 18 A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-
19 framed entrances and storefronts representing those indicated for this Project without failure due to defective
20 manufacture, fabrication, installation, or other defects in construction.

- 21 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including,
22 but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and
23 concentrated live loads.
24 2. Failure also includes the following:

- 25 a. Thermal stresses transferring to building structure.
26 b. Glass breakage.
27 c. Noise or vibration created by wind and thermal and structural movements.
28 d. Loosening or weakening of fasteners, attachments, and other components.
29 e. Failure of operating units.

- 30 B. Structural Loads:

- 31 1. Wind Loads: As indicated on Drawings.

- 32 C. Deflection of Framing Members: At design wind pressure, as follows:

- 33 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not
34 exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge
35 deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
36 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch (3.2 mm), whichever is
37 smaller.

- 1 D. Structural: Test according to ASTM E 330/E 330M as follows:
- 2 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance
3 doors, do not evidence deflection exceeding specified limits.
- 4 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies,
5 including entrance doors and anchorage, do not evidence material failures, structural distress, or
6 permanent deformation of main framing members exceeding 0.2 percent of span.
- 7 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- 8 E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
- 9 1. Fixed Framing and Glass Area:
- 10 a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of
11 1.57 lbf/sq. ft. (75 Pa).
- 12 2. Entrance Doors:
- 13 a. Single and double doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential
14 of 1.57 lbf/sq. ft. (75 Pa).
- 15 F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
- 16 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when
17 tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design
18 pressure, but not less than 10 lbf/sq. ft. (480 Pa).
- 19 G. Energy Performance: Certify and label energy performance according to NFRC as follows:
- 20 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not
21 more than 0.32 Btu/sq. ft. x h x deg F as determined according to AAMA 1503.
- 22 2. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified
23 condensation resistance rating of no less than 60 as determined according to CSA A-440.
- 24 H. Noise Reduction: Test according to ASTM E 90, with ratings determined by ASTM E 1332, as follows.
- 25 1. Outdoor-Indoor Transmission Class: Minimum 28.
- 26 I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
- 27 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

28 2.3 STOREFRONT SYSTEMS

- 29 A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc.; Kawneer
30 Aluminum Storefront System: Outside (Front) Set TRIFAB VG 451 (non-thermal interior) and 451UT (thermal
31 exterior) Framing or comparable product by one of the following:
- 32
- 33 1. Arch Aluminum & Glass Co., Inc.
- 34 2. CMI Architectural.
- 35 3. EFCO Corporation.
- 36 4. Leed Himmel Industries, Inc.
- 37 5. Pittco Architectural Metals, Inc.
- 38 6. TRACO.
- 39 7. Tubelite.
- 40 8. United States Aluminum.

- 1 9. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
- 2 B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and
3 reinforced as required to support imposed loads.
- 4 1. Exterior Framing Construction: Thermally broken with high-performance polyurethane (2) connectors.
5 2. Interior Vestibule Framing Construction: Nonthermal.
6 3. Glazing System: Retained mechanically with gaskets on four sides.
7 4. Glazing Plane: Front.
8 5. Finish: Color anodic finish.
9 6. Fabrication Method: Field-fabricated stick system.
10 7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
11 8. Steel Reinforcement: As required by manufacturer.
- 12 C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where
13 framing abuts adjacent construction.
- 14 D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims
15 for aligning system components.

16 2.4 ENTRANCE DOOR SYSTEMS

- 17 A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc.; Kawneer
18 Aluminum Storefront System: AA 425 Thermal Entrances (exterior) and Standard Entrances (interior) or comparable
19 product by one of the following:
20
- 21 1. Arch Aluminum & Glass Co., Inc.
22 2. CMI Architectural.
23 3. EFCO Corporation.
24 4. Leed Himmel Industries, Inc.
25 5. Pittco Architectural Metals, Inc.
26 6. TRACO.
27 7. Tubelite.
28 8. United States Aluminum.
29 9. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
- 30 B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
- 31 1. Door Construction: 2-1/4-inch (57.2-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick,
32 extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets
33 that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
- 34 a. Thermal Construction: High-performance polyurethane (2) connectors which separate aluminum
35 members exposed to the exterior from members exposed to the interior.
- 36 2. Door Design: Wide stile; 4 1/4-inch.
37 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
- 38 a. Provide nonremovable glazing stops on outside of door.

39 2.5 ENTRANCE DOOR HARDWARE

- 40 A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
41 B. Cylinders: As specified in Section 087100 "Door Hardware."

- 1 C. Weather Stripping: Manufacturer's standard replaceable components.
- 2 1. Compression Type: Made of ASTM D 2000 molded neoprene or ASTM D 2287 molded PVC.
- 3 2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or
- 4 aluminum-strip backing.
- 5 D. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting
- 6 strip.
- 7 2.6 GLAZING
- 8 A. Glazing: Comply with Section 088000 "Glazing."
- 9 B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric
- 10 glazing gaskets, setting blocks, and shims or spacers.
- 11 2.7 MATERIALS
- 12 A. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
- 13 B. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
- 14 C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- 15 D. Structural Profiles: ASTM B 308/B 308M.
- 16 2.8 ACCESSORIES
- 17 A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and
- 18 accessories compatible with adjacent materials.
- 19 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural
- 20 movements, wind loads, or vibration.
- 21 2. Reinforce members as required to receive fastener threads.
- 22 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- 23 B. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch (25.4 mm)** that accommodate
- 24 fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended
- 25 by manufacturer.
- 26 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with
- 27 ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- 28 C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible
- 29 with adjacent materials.
- 30 D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for **30-mil (0.762-mm)**
- 31 thickness per coat.
- 32 E. Rigid PVC Filler.

- 1 2.9 FABRICATION
- 2 A. Form or extrude aluminum shapes before finishing.
- 3 B. Fabricate components that, when assembled, have the following characteristics:
- 4 1. Profiles that are sharp, straight, and free of defects or deformations.
- 5 2. Accurately fitted joints with ends coped or mitered.
- 6 3. Physical and thermal isolation of glazing from framing members.
- 7 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required
- 8 glazing edge clearances.
- 9 5. Provisions for field replacement of glazing from interior.
- 10 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- 11 C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- 12 D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing
- 13 entrance door hardware.
- 14 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- 15 E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- 16 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised
- 17 into door edge.
- 18 2. At exterior doors, provide weather sweeps applied to door bottoms.
- 19 F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut,
- 20 drill, and tap for factory-installed entrance door hardware before applying finishes.
- 21 G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.
- 22 2.10 ALUMINUM FINISHES
- 23 A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
- 24 1. Color: Light bronze.
- 25 2. Color: Match Architect's sample.
- 26 PART 3 - EXECUTION
- 27 3.1 EXAMINATION
- 28 A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other
- 29 conditions affecting performance of the Work.
- 30 B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 31 3.2 INSTALLATION
- 32 A. General:

- 1 1. Comply with manufacturer's written instructions.
 - 2 2. Do not install damaged components.
 - 3 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4 4. Rigidly secure nonmovement joints.
 - 5 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and
 - 6 to prevent impeding movement of moving joints.
 - 7 6. Seal perimeter and other joints watertight unless otherwise indicated.
- 8 B. Metal Protection:
- 9 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact
 - 10 surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive
 - 11 spacers.
 - 12 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact
 - 13 surfaces with bituminous paint.
- 14 C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to
- 15 produce weathertight installation.
- 16 D. Install components plumb and true in alignment with established lines and grades.
- 17 E. Install glazing as specified in Section 088000 "Glazing."
- 18 F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
- 19 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

20 3.3 ERECTION TOLERANCES

- 21 A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum
- 22 tolerances:
- 23 1. Plumb: **1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
 - 24 2. Level: **1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).**
 - 25 3. Alignment:
 - 26 a. Where surfaces abut in line or are separated by reveal or protruding element up to **1/2 inch (12.7**
 - 27 **mm)** wide, limit offset from true alignment to **1/16 inch (1.6 mm).**
 - 28 b. Where surfaces are separated by reveal or protruding element from **1/2 to 1 inch (12.7 to 25.4 mm)**
 - 29 wide, limit offset from true alignment to **1/8 inch (3.2 mm).**
 - 30 c. Where surfaces are separated by reveal or protruding element of **1 inch (25.4 mm)** wide or more,
 - 31 limit offset from true alignment to **1/4 inch (6 mm).**
 - 32 4. Location: Limit variation from plane to **1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm)** over total
 - 33 length.

34 END OF SECTION 084113

1 SECTION 085113 - ALUMINUM WINDOWS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes aluminum windows for exterior locations.

- 8 B. Related Requirements:

- 9 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum
10 fenestration units.

11 1.3 PREINSTALLATION MEETINGS

- 12 A. Preinstallation Conference: Conduct conference at Project site.

- 13 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel,
14 equipment, and facilities needed to make progress and avoid delays.
15 2. Review and discuss the finishing of aluminum windows that is required to be coordinated with the finishing
16 of other aluminum work for color and finish matching.
17 3. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall
18 components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting
19 finishes.
20 4. Review and discuss the sequence of work required to construct a watertight and weathertight exterior
21 building envelope.
22 5. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

23 1.4 ACTION SUBMITTALS

- 24 A. Product Data: For each type of product.

- 25 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of
26 individual components and profiles, hardware, and finishes for aluminum windows.

- 27 B. Sustainable Design Submittal.

- 28 1. Product Data for Credit EQ 4.1: For glazing sealants, including printed statement of VOC content and
29 chemical components.
30 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
31 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
32 product having recycled content.
33 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
34 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
35 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
36 material, and fraction by weight that is considered regional.
37

- 1 C. Shop Drawings: For aluminum windows.
- 2 1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and
3 details of installation, including anchor, flashing, and sealant installation.
- 4 D. Samples: For each exposed product and for each color specified, **2 by 4 inches (50 by 100 mm)** in size.
- 5 E. Samples for Initial Selection: For units with factory-applied finishes.
- 6 1. Include Samples of hardware and accessories involving color selection.
- 7 F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

8 1.5 INFORMATIONAL SUBMITTALS

- 9 A. Qualification Data: For manufacturer and Installer.
- 10 B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- 11 C. Sample Warranties: For manufacturer's warranties.

12 1.6 QUALITY ASSURANCE

- 13 A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed
14 performance requirements indicated and of documenting this performance by test reports and calculations.
- 15 B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required
16 for this Project.

17 1.7 WARRANTY

- 18 A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or
19 workmanship within specified warranty period.
- 20 1. Failures include, but are not limited to, the following:
- 21 a. Failure to meet performance requirements.
- 22 b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
- 23 c. Faulty operation of movable sash and hardware.
- 24 d. Deterioration of materials and finishes beyond normal weathering.
- 25 e. Failure of insulating glass.
- 26 2. Warranty Period:
- 27 a. Window: 10 years from date of Substantial Completion.

28 PART 2 - PRODUCTS

29 2.1 MANUFACTURERS

- 30 A. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

- 1 2.2 WINDOW PERFORMANCE REQUIREMENTS
- 2 A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of
3 performance, materials, components, accessories, and fabrication unless more stringent requirements are
4 indicated.
- 5 1. Window Certification: AAMA certified with label attached to each window.
- 6 B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
- 7 1. Minimum Performance Class: AW.
8 2. Minimum Performance Grade: PG70.
- 9 C. Air Infiltration: Test according to ASTM E 283 (minimum size of 60" x 99") for infiltration as follows:
- 10 1. Fixed Framing and Glass Area:
- 11 a. Maximum air leakage of 0.10 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
- 12 D. Water Penetration under Static Pressure: Test according to ASTM E 331(minimum size of 60" x 99") as follows:
- 13 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when
14 tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design
15 pressure, but not less than 15 lbf/sq. ft.
- 16 E. Thermal Transmittance: AAMA 1503 maximum whole-window U-factor of 0.31 Btu/sq. ft. x h x deg F.
- 17 F. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to
18 AAMA 1503, showing a CRF of 77.
- 19 G. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting
20 from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening
21 of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental
22 effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and
23 nighttime-sky heat loss.
- 24 1. Temperature Change: 120 deg F (67 deg C) ambient; 180 deg F (100 deg C) material surfaces.
- 25 H. Sound Transmission Class (STC): Rated for not less than [26] [30] <Insert rating> STC when tested for laboratory
26 sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
- 27 I. Outside-Inside Transmission Class (OITC): Rated for not less than 32 OITC when tested for laboratory sound
28 transmission loss according to AAMA 1801.

29 2.3 ALUMINUM WINDOWS

- 30 A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc., AA 6600
31 Thermal AW-PG70-FW Fixed Window or a comparable product.
- 32 B. Types: Provide the following types in locations indicated on Drawings:
- 33 1. Fixed.
- 34 C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

- 1 1. Thermally Broken Construction: Fabricate frames, sashes, and muntins with a fiber-reinforced nylon strips
 2 continuously and mechanically bonded between exterior materials and window members exposed on
 3 interior side in a manner that eliminates direct metal-to-metal contact.
- 4 D. GLAZING
- 5
- 6 1. Glazing: Comply with Section 088000 "Glazing."
 7 2. Glazing Gaskets: Manufacturer's standard dry type, TPE glazing gaskets, setting blocks, and shims or
 8 spacers.
- 9 E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
- 10 2.4 ACCESSORIES
- 11 A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
- 12 B. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
- 13 C. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors
 14 windows in place.
- 15 D. Framing system gaskets, joint fillers, and caulk stops.
- 16 2.5 FABRICATION
- 17 A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and
 18 anchoring windows.
- 19 B. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
- 20 C. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent
 21 possible. Disassemble components only as necessary for shipment and installation.
- 22 2.6 GENERAL FINISH REQUIREMENTS
- 23 A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
- 24 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
 25 covering before shipping.
- 26 C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
 27 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
 28 installed to minimize contrast.
- 29 2.7 ALUMINUM FINISHES
- 30 A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating
 31 aluminum finishes.
- 32 B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish:
 33 etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color
 34 coating 0.018 mm or thicker) complying with AAMA 611.

- 1 1. Color: Light bronze.
- 2 2. Color: Match Architect's sample.

3 PART 3 - EXECUTION

4 3.1 EXAMINATION

- 5 A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance
6 with requirements for installation tolerances and other conditions affecting performance of the Work.
- 7 B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- 8 C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure
9 weathertight window installation.
- 10 D. Proceed with installation only after unsatisfactory conditions have been corrected.

11 3.2 INSTALLATION

- 12 A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other
13 components. For installation procedures and requirements not addressed in manufacturer's written instructions,
14 comply with installation requirements in ASTM E 2112.
- 15 B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored
16 securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to
17 produce weathertight construction.
- 18 C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within
19 windows to the exterior.
- 20 D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of
21 contact with other materials.

22 3.3 ADJUSTING, CLEANING, AND PROTECTION

- 23 A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation
24 and weathertight closure.
- 25 B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes.
26 Remove excess sealants, glazing materials, dirt, and other substances.
 - 27 1. Keep protective films and coverings in place until final cleaning.
- 28 C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction
29 period.
- 30 D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If
31 contaminating substances do contact window surfaces, remove contaminants immediately according to
32 manufacturer's written instructions.

33 END OF SECTION 085113

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1 SECTION 085669 - BULLET-RESISTANT TRANSACTION WINDOWS

2

3 PART 1 GENERAL

4

5 1.1 SUMMARY

6

7 A. Section Includes:

- 8 1. Bullet-resistant fixed aluminum transaction window assemblies.

9

10 1.2 REFERENCES

11

- 12 A. American Welding Society (AWS) D1.2/D1.2M - Structural Welding Code - Aluminum.

13

- 14 B. American Architectural Manufacturers Association 611 - Voluntary Specification for Anodized Architectural Aluminum.

15

- 16 C. ASTM International (ASTM) B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

17

- 18 D. Underwriters Laboratories (UL) 752 - Bullet Resisting Equipment.

19

20 1.3 SYSTEM DESCRIPTION

21

22 A. Design Requirements:

23

- 24 1. Provide window frames of "non-ricochet type" intended to permit capture and retention of attacking projectile, lessening potential of random injury or lateral penetration.

- 25 2. Two way "natural voice" communication permitted by design of vertical side frames and glazing technique.

26

27 1.4 SUBMITTALS

28

29 A. Submittals for Review:

30

- 31 1. Shop Drawings: Include window profiles and sizes, type and spacing of frame anchors, reinforcement size and locations, details of joints and connections, and welding details.

- 32 2. Product Data: Include product description for window assemblies including bullet-resistant ratings.

33

34 A. Sustainable Design Submittal.

35

- 36 1. Product Data for Credit EQ 4.1: For glazing sealants, including printed statement of VOC content and chemical components.

- 37 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

- 38 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

39

40 B. Closeout Submittals:

- 41 1. Maintenance Data: Include instructions for cleaning of glazed panels.

42

43 1.5 QUALITY ASSURANCE

44

- 45 A. Transaction Window Assemblies: Ballistic Level 3 tested to UL 752.

46

47 1.6 PROJECT CONDITIONS

48

1 A. Field measurements: Check opening by accurate field measurement before fabrication. Show recorded measurements on
2 shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

3 1.7 DELIVERY, STORAGE AND HANDLING

4
5 A. Store window assemblies upright in protected, dry area, off ground or floor, with at least 1/4 inch space between
6 individual units.

7
8 B. Do not cover with non vented coverings that create excessive humidity.

9
10 C. Remove wet coverings immediately.

11
12 PART 2 PRODUCTS

13
14 2.1 MANUFACTURERS

15
16 A. Contract Documents are based on products by ARMORTEX, 5926 Corridor Parkway, Schertz, Texas, 800-880-8306,
17 www.armortex.com.

18
19 2.2 MATERIALS

20
21 A. Frames: Stainless Steel bullet resistant frame modules shall be to the standards established by U.L. 752 Protection Level 3.
22 Frames are to be constructed of 16 ga. stainless steel # 4 finish lined with U.L. listed bullet resistant fiberglass for level 3.
23 All joints are mitered and welded. All exposed welds shall be ground flush and finished smooth. Replacement of glazing
24 shall be from the secure side of the window or wall unit and does not require the removal of the frame from the opening.
25 Shapes and sizes are to be in accordance with the contract drawings. FRAMES MUST UTILIZE TESTING RECOGNIZED UNDER
26 THE STANDARDS ESTABLISHED BY U.L. 752 FOR BULLET RESISTANT COMPONENTS.

27 B. Finish: # 4 stainless steel

28 C. Bullet-Resistant Composite: UL Listed Bullet Resistant Composite

29 D. Glazing:

30 1. UL 752 Listed laminated glass.

31 2. Bottom edge of glazing panel provided with 18 gage stainless steel cap.

32
33 2.3 FABRICATION

34
35 A. Frames:

36 1. Fabricate from stainless steel lined with bullet-resistant composite.

37 2. Weld frame corners.

38 3. Frame modules capable of being joined with other frame modules to form continuous line.

39 4. Replacement of glazing from secure side of window, not requiring removal of frame from opening.

40
41 B. Dip Tray: Model RMDT1016, 16 gage stainless steel, 10 x 16 inches to outside edge of flanges, clear 1-5/8 inch open depth
42 under glazing.

43
44 C. Surround Sound:

45 1. For interior windows only. Provide for two way "natural voice" or "surround sound" communication permitted by
46 the design of the window jambs and glazing technique. Units must be manufactured in strict accordance with the
47 specifications, design and details. No field alterations to the construction of the units fabricated under the
48 acceptable standards shall be allowed unless approved by the manufacturer and the architect

49 D. Shelf:

50 1. Provide a shelf not less than 2" thick with recessed deal tray. The shelf is to be the full width of the window and a
51 minimum of 12" deep centered under the glazing. 16 ga. stainless steel with No. 4 finish.

52
53 E. Welding: In accordance with AWS D1.2/D1.2M. Grind exposed welds flush and smooth.

54
55 F. Finish work neat and free from defects.

56
57 G. Allowable Tolerances: Plus or minus 1/16 inch for frame opening width, height, diagonal dimensions, and overall width and
58 height (outside to outside).

59
60
61 PART 3 EXECUTION

1 3.1 INSTALLATION

2

3 A. Install window assemblies in accordance with manufacturer's instructions and approved Shop Drawings.

4

5 B. Set plumb, square, and level.

6

7 C. Secure to adjacent construction using fastener type best suited to application.

8

9 D. Field alterations to window assemblies not permitted unless approved in advance by manufacturer.

10

11

12 END OF SECTION

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1 SECTION 086300 – INCLINED SKYLIGHTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes metal framed inclined skylight.

8 1.3 ACTION SUBMITTALS

- 9 A. Product Data: For each type of product.

- 10 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
11 finishes for metal-framed skylights.

- 12 B. Sustainable Design Submittal.

- 13
14 1. Product Data for Credit EQ 4.1: For glazing sealants, including printed statement of VOC content and
15 chemical components.
16 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
17 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
18 product having recycled content.
19 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
20 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
21 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
22 material, and fraction by weight that is considered regional.

- 23 C. Shop Drawings: For metal-framed skylights.

- 24 1. Include plans, elevations, sections, and attachment details.
25 2. Indicate structural loadings and reactions to be transmitted to supporting construction.
26 3. Include details of provisions for assembly expansion and contraction.
27 4. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the
28 following:

- 29 a. Joinery including concealed welds.
30 b. Anchorage.
31 c. Expansion provisions.
32 d. Glazing.

- 33 D. Samples for Initial Selection: For units with factory-applied finishes.

- 34 E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

- 35 F. Delegated-Design Submittal: For metal-framed skylights indicated to comply with performance requirements and
36 design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their
37 preparation.

- 1 1.4 INFORMATIONAL SUBMITTALS
- 2 A. Qualification Data: For Installer.
- 3 B. Sample Warranties: For special warranties.
- 4 1.5 QUALITY ASSURANCE
- 5 A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of
6 metal-framed skylights required for this Project.
- 7 1.6 WARRANTY
- 8 A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of metal framed skylights that fail
9 in materials or workmanship within specified warranty period.
- 10 1. Failures include, but are not limited to, the following:
- 11 a. Structural failures including, but not limited to, excessive deflection.
- 12 b. Noise or vibration caused by thermal movements.
- 13 2. Warranty Period: **Two** years from date of Substantial Completion.
- 14 PART 2 - PRODUCTS
- 15 2.1 PERFORMANCE REQUIREMENTS
- 16 A. Delegated Design: Engage a qualified professional engineer to design metal-framed skylights.
- 17 B. Deflection of Framing Members: At design wind pressure, as follows:
- 18 1. Deflection Normal to Glazing Plane: Limited to **edge of glass in a direction perpendicular to glass plane not**
19 **exceeding L/175 of the glass edge length for each individual glazing lite** or an amount that restricts edge
20 deflection of individual glazing lites to **3/4 inch (19.1 mm)**, whichever is less.
- 21 2. Deflection Parallel to Glazing Plane: Limited to **L/360 of clear span or 1/8 inch (3.2 mm)**, whichever is
22 **smaller**.
- 23 2.2 METAL-FRAMED SKYLIGHTS
- 24 A. Metal-Framed Skylights: Glazed skylight assemblies supported by aluminum framing.
- 25 B. Aluminum Framing Systems: Manufacturer's standard extruded-aluminum members of thickness required and
26 reinforced as required to support imposed loads.
- 27 C. Aluminum: Alloy and temper as recommended in writing by manufacturer for type of use and finish indicated.
- 28 1. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
- 29 2. Extruded Bars, Rods, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
- 30 3. Extruded Structural Pipe and Tubes: **ASTM B 429/B 429M**.
- 31 4. Structural Profiles: **ASTM B 308/B 308M**.

- 1 D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
- 2 1. Include aluminum trim that conceals fasteners.
- 3 E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims
- 4 for aligning skylight components.
- 5 F. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and
- 6 accessories compatible with adjacent materials.
- 7 1. At pressure caps, use ASTM A 193/A 193M stainless-steel screws.
- 8 2. Reinforce members as required to receive fastener threads.
- 9 3. Use exposed fasteners with countersunk Phillips screw heads, **finished to match framing system.**
- 10 G. Anchor Bolts: ASTM A 307, Grade A, galvanized steel.
- 11 H. Framing Sealants: As **recommended in writing by manufacturer.**
- 12 I. Rafter spacing: **Provide custom** spacing and widths as indicated on the Drawings.
- 13 J. Ends: **Wall Abutment**
- 14 K. Glazing: **Lexan XL10 polycarbonate plastic glazing.**

15 2.3 FABRICATION

- 16 A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at
- 17 Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- 18 B. Fabricate aluminum components that, when assembled, have the following characteristics:
- 19 1. Profiles that are sharp, straight, and free of defects or deformations.
- 20 2. Accurately fitted joints with ends coped or mitered.
- 21 3. Internal guttering systems or other means to drain water passing joints and moisture migrating within
- 22 skylight to exterior.
- 23 4. Physical and thermal isolation of glazing from framing members.
- 24 5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required
- 25 glazing edge clearances.
- 26 C. Fabricate aluminum sill closures with weep holes and for installation as continuous component.
- 27 D. Reinforce aluminum components as required to receive fastener threads.
- 28 E. Factory-Glazed, Metal-Framed Skylights:
- 29 F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

30 2.4 ALUMINUM FINISHES

- 31 A. Clear Anodic Finish: AAMA 611, **AA-M12C22A41, Class I, 0.018 mm** or thicker.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

- 3 A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances
4 and other conditions affecting performance of the Work.
- 5 B. Proceed with installation only after unsatisfactory conditions have been corrected.

6 3.2 INSTALLATION

- 7 A. General: Comply with manufacturer's written instructions.

- 8 1. Do not install damaged components.
9 2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
10 3. Rigidly secure nonmovement joints.
11 4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and
12 to prevent impeding movement of moving joints.

- 13 B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting
14 contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by
15 manufacturer for this purpose.

- 16 C. Install continuous aluminum sill closure with expansion joints and locked and sealed corners.

- 17 D. Install components plumb and true in alignment with established lines and elevations.

- 18 E. Glazing: Install glazing.

- 19 F. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:

- 20 1. Alignment: Limit offset from true alignment to **1/32 inch (0.8 mm)** where surfaces abut in line, edge to
21 edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than **3 inches**
22 **(76 mm)**; otherwise, limit offset to **1/8 inch (3.2 mm)**.
23 2. Location and Plane: Limit variation from true location and plane to **1/8 inch in 12 feet (3.2 mm in 3.7 m)** but
24 no greater than **1/2 inch (13 mm)** over total length.

25 3.3 CLEANING AND PROTECTION

- 26 A. Clean exposed surfaces immediately after installing skylights. Avoid damaging protective coatings and finishes.
27 Remove excess sealants, glazing materials, dirt, and other substances.

- 28 B. Remove and replace **plastic glazing** that has been broken, chipped, cracked, abraded, or damaged during
29 construction period.

- 30 C. Protect skylights from contact with contaminating substances resulting from construction operations. If
31 contaminating substances do contact skylight surfaces, remove contaminants immediately according to
32 manufacturer's written instructions.

33 END OF SECTION 086300

1 SECTION 087100 – DOOR HARDWARE

2 GENERAL

3 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and
5 Division 01 Specification Sections, apply to this Section.

6 SUMMARY

7 A. Section includes:

- 8 1. Mechanical and electrified door hardware for:
9 a. Swinging doors.
10 2. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

11 B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

- 12 1. Windows
13 2. Cabinets (casework), including locks in cabinets
14 3. Signage
15 4. Toilet accessories
16 5. Overhead doors

17 C. Related Sections:

- 18 1. Division 01 Section "Alternates" for alternates affecting this section.
19 2. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in
20 this section.
21 3. Division 09 sections for touchup finishing or refinishing of existing openings modified by this section.
22 4. Division 26 sections for connections to electrical power system and for low-voltage wiring.
23 5. Division 28 sections for coordination with other components of electronic access control system.

24 REFERENCES

25 A. Fire/Life Safety

- 26 1. NFPA - National Fire Protection Association
27 a. NFPA 70 – National Electric Code
28 b. NFPA 80 - Standard for Fire Doors and Fire Windows
29 c. NFPA 101 - Life Safety Code
30 d. NFPA 105 - Smoke and Draft Control Door Assemblies

31 2. State Fire Safety Code.

32 B. UL - Underwriters Laboratories

- 33 1. UL 10B - Fire Test of Door Assemblies
34 2. UL 10C - Positive Pressure Test of Fire Door Assemblies

- 1 3. UL 1784 - Air Leakage Tests of Door Assemblies
- 2 4. UL 305 - Panic Hardware

- 3 C. Accessibility

- 4 1. ADA - Americans with Disabilities Act.
- 5 2. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

- 6 D. DHI - Door and Hardware Institute

- 7 1. Sequence and Format for the Hardware Schedule
- 8 2. Recommended Locations for Builders Hardware
- 9 3. Key Systems and Nomenclature

- 10 E. ANSI - American National Standards Institute

- 11 1. ANSI/BHMA A156.1 - A156.29, and ANSI A156.31 - Standards for Hardware and Specialties

- 12 SUBMITTALS

- 13 A. General:

- 14 1. Submit in accordance with Conditions of Contract and Division 01 requirements.
- 15 2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- 16 3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.

- 17 18

- 19 B. Action Submittals:

- 20 1. Product Data: Product data including manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- 21 2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
- 22 23 a. Wiring Diagrams: For power, signal, and control wiring and including:
- 24 25 1) Details of interface of electrified door hardware and building safety and security systems.
- 26 27 2) Schematic diagram of systems that interface with electrified door hardware.
- 28 28 3) Point-to-point wiring.
- 29 29 4) Risers.

- 30 3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.
- 31 32

- 33 a. Samples will be returned to supplier in like-new condition. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
- 34 35

- 36 4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:
- 37 38

- 39 a. Door Index; include door number, heading number, and Architects hardware set number.
- 40 b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
- 41 c. Type, style, function, size, and finish of each hardware item.
- 42 d. Name and manufacturer of each item.

- 1 e. Fastenings and other pertinent information.
- 2 f. Location of each hardware set cross-referenced to indications on Drawings.
- 3 g. Explanation of all abbreviations, symbols, and codes contained in schedule.
- 4 h. Mounting locations for hardware.
- 5 i. Door and frame sizes and materials.
- 6 j. Name and phone number for local manufacturer's representative for each product.
- 7 k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks,
- 8 electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units,
- 9 and access control components). Operational description should include how door will operate on
- 10 egress, ingress, and fire and smoke alarm connection.
- 11 1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product
- 12 Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with
- 13 scheduling requirements of other work to facilitate fabrication of other work that is critical in
- 14 Project construction schedule.

- 15 5. Key Schedule:
- 16 a. Cylinders and keying provided by owner.
- 17 6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work
- 18 specified to be factory prepared for door hardware installation.

- 19 C. Informational Submittals:
- 20 1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
- 21 2. Product Certificates for electrified door hardware, signed by manufacturer:
- 22 a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies
- 23 with listed fire-rated door assemblies.
- 24 3. Certificates of Compliance:
- 25 a. Certificates of compliance for fire-rated hardware and installation instructions if requested by Architect
- 26 or Authority Having Jurisdiction.
- 27 b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to
- 28 completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
- 29 c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by
- 30 Contractor, attesting to completion of electrified hardware coordination conference, specified in
- 31 "QUALITY ASSURANCE" article, herein.
- 32 4. Product Test Reports: For compliance with accessibility requirements, based on evaluation of
- 33 comprehensive tests performed by manufacturer and witnessed by qualified testing agency, for door
- 34 hardware on doors located in accessible routes.
- 35 5. Warranty: Special warranty specified in this Section.

- 36 D. Closeout Submittals:
- 37 1. Operations and Maintenance Data : Provide in accordance with Division 01 and include:
- 38 a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts,
- 39 and information on preservation of finishes.
- 40 b. Catalog pages for each product.
- 41 c. Name, address, and phone number of local representative for each manufacturer.
- 42 d. Parts list for each product.
- 43 e. Final approved hardware schedule, edited to reflect conditions as-installed.
- 44 f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
- 45 g. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

- 1 QUALITY ASSURANCE
- 2 A. Product Substitutions: Comply with product requirements stated in Division 01 and as specified herein.
- 3 1. Where specific manufacturer’s product is named and accompanied by “No Substitute,” including make or
4 model number or other designation, provide product specified. (Note: Certain products have been selected
5 for their unique characteristics and particular project suitability.)
- 6 a. Where no additional products or manufacturers are listed in product category, requirements for “No
7 Substitute” govern product selection.
- 8 2. Where products indicate “acceptable substitute” or “acceptable manufacturer”, provide product from
9 specified manufacturers, subject to compliance with specified requirements and “Single Source
10 Responsibility” requirements stated herein.
- 11 B. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful
12 in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for
13 this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect,
14 and Contractor, at reasonable times during the Work for consultation.
- 15 1. Warehousing Facilities: In Project’s vicinity.
16 2. Scheduling Responsibility: Preparation of door hardware schedules.
17 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings,
18 based on testing and engineering analysis of manufacturer’s standard units in assemblies similar to those
19 indicated for this Project.
20 4. Coordination Responsibility: Coordinate installation of electronic security hardware with Architect and
21 electrical engineers and provide installation and technical data to Architect and other related
22 subcontractors.
- 23 a. Upon completion of electronic security hardware installation, inspect and verify that all components
24 are working properly.
- 25 C. Installer Qualifications: Qualified tradesmen, skilled in application of commercial grade hardware with record of
26 successful in-service performance for installing door hardware similar in quantity, type, and quality to that
27 indicated for this Project.
- 28 D. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for
29 door hardware installations that are comparable in material, design, and extent to that indicated for this Project
30 and meets these requirements:
- 31 1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
32 2. Can provide installation and technical data to Architect and other related subcontractors.
33 3. Can inspect and verify components are in working order upon completion of installation.
34 4. Capable of producing wiring diagrams.
35 5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.
- 36 E. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
- 37 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise
38 indicated.
39 2. Manufacturers that perform electrical modifications and that are listed by testing and inspecting agency
40 acceptable to authorities having jurisdiction are acceptable.
- 41 F. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and
42 requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are
43 identical to products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and
44 inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors
45 indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with
46 requirements of fire-rated door and door frame labels.

- 1 G. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required,
2 provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in
3 compliance with NFPA 105.
- 4 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure
5 differential of 0.3-inch wg (75 Pa) of water.
- 6 H. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to
7 authorities having jurisdiction.
- 8 I. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release latch. Locks do not require use
9 of key, tool, or special knowledge for operation.
- 10 J. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing
11 accessibility regulations cited in "REFERENCES" article, herein.
- 12 1. Provide operating devices that do not require tight grasping, pinching, or twisting of wrist and that operate
13 with force of not more than 5 lbf (22.2 N).
14 2. Maximum opening-force requirements:
- 15 a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
16 b. Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
17 c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- 18 3. Bevel raised thresholds with slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13
19 mm) high.
20 4. Adjust door closer sweep periods so that, from open position of 70 degrees, door will take at least 3
21 seconds to move to 3 inches (75 mm) from latch, measured to leading edge of door.
- 22 K. Keying Conference: Cylinders and keying provided by owner.
- 23 L. Pre-installation Conference: Conduct conference at Project site.
- 24 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel,
25 equipment, and facilities needed to make progress and avoid delays.
26 2. Inspect and discuss preparatory work performed by other trades.
27 3. Inspect and discuss electrical roughing-in for electrified door hardware.
28 4. Review sequence of operation for each type of electrified door hardware.
29 5. Review required testing, inspecting, and certifying procedures.
- 30 M. Coordination Conferences:
- 31 1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review
32 questions or concerns related to proper installation and adjustment of door hardware.
- 33 a. Attendees: Door hardware supplier, door hardware installer, Contractor.
34 b. After meeting, provide letter of compliance to Architect, indicating when meeting was held and who
35 was in attendance.
- 36 2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold
37 meeting to coordinate door hardware with security, electrical, doors and frames, and other related
38 suppliers.
- 39 a. Attendees: electrified door hardware supplier, doors and frames supplier, electrified door hardware
40 installer, electrical subcontractor, Owner, Owner's security consultant, Architect and Contractor.
41 b. After meeting, provide letter of compliance to Architect, indicating when coordination conference was
42 held and who was in attendance.

1 DELIVERY, STORAGE, AND HANDLING

- 2 A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.
- 3 B. Tag each item or package separately with identification coordinated with final door hardware schedule, and
4 include installation instructions, templates, and necessary fasteners with each item or package.
- 5 1. Deliver each article of hardware in manufacturer's original packaging.
- 6 C. Project Conditions:
- 7 1. Maintain manufacturer-recommended environmental conditions throughout storage and installation
8 periods.
- 9 2. Provide secure lock-up for door hardware delivered to Project, but not yet installed. Control handling and
10 installation of hardware items so that completion of Work will not be delayed by hardware losses both
11 before and after installation.
- 12 D. Protection and Damage:
- 13 1. Promptly replace products damaged during shipping.
- 14 2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products
15 damaged during Work.
- 16 3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

17 COORDINATION

- 18 A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring
19 inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- 20 B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check
21 Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door
22 hardware to comply with indicated requirements.
- 23 C. Security: Coordinate installation of door hardware, and access control with Owner's security consultant.
- 24 D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections
25 to power supplies and building safety and security systems.
- 26 E. Existing Openings: Where hardware components are scheduled for application to existing construction or where
27 modifications to existing door hardware are required, field verify existing conditions and coordinate installation
28 of door hardware to suit opening conditions and to provide proper door operation.
- 29 F. Direct shipments not permitted, unless approved by Contractor.

30 WARRANTY

- 31 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components
32 of door hardware that fail in materials or workmanship within specified warranty period.
- 33 1. Warranty Period: Years from date of Substantial Completion, for durations indicated.
- 34 a. Closers:
- 35 1) Mechanical: 10 years.
- 36 2) Electrified: 2 years.
- 37 b. Exit Devices:

- 1 1) Mechanical: 3 years.
2 2) Electrified: 1 year.
- 3 c. Locksets:
4 1) Mechanical: 3 years.
5 2) Electrified: 1 year.
- 6 d. Continuous Hinges: Lifetime warranty.
- 7 2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

8 MAINTENANCE

- 9 A. Maintenance Tools:
- 10 1. Furnish complete set of special tools required for maintenance and adjustment of hardware, including
11 changing of cylinders.

12 PRODUCTS

13 MANUFACTURERS

- 14 A. The Owner requires use of certain products for their unique characteristics and particular project suitability to
15 insure continuity of existing and future performance and maintenance standards. After investigating available
16 product offerings Awarding Authority has elected to prepare proprietary specifications. These products are
17 specified with the notation: "No Substitute."
- 18 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be
19 considered.
- 20 B. Approval of manufacturers other than those listed shall be in accordance with QUALITY ASSURANCE article,
21 herein.
- 22 C. Approval of products from manufacturers indicated as "Acceptable Manufacturer" is contingent upon those
23 products providing all functions and features and meeting all requirements of scheduled manufacturer's
24 product.
- 25 D. Hand of Door: Drawings show direction of slide, swing, or hand of each door leaf. Furnish each item of
26 hardware for proper installation and operation of door movement as shown.
- 27 E. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish
28 suitable types having same operation and quality as type specified, subject to Architect's approval.

29 MATERIALS

- 30 A. Fasteners
- 31 1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw
32 installation.
- 33 2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition)
34 screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work
35 including prepared for paint surfaces to receive painted finish.
- 36 3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units
37 of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt

1 head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware
2 securely. Review door specification and advise Architect if thru-bolts are required.
3 4. Install hardware with fasteners provided by hardware manufacturer.

4 B. Modification and Preparation of Existing Doors: Provide necessary fillers, Dutchmen, reinforcements, and
5 fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover
6 existing door and frame preparations.

7 1. Use materials which match materials of adjacent modified areas.
8 2. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to
9 maintain fire-rating.

10 C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

11 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

12 HINGES

13 A. Provide five-knuckle, ball bearing hinges.

14 1. Manufacturers and Products:

- 15 a. Scheduled Manufacturer and Product: Ives 5BB series.
16 b. Acceptable Manufacturers: Stanley, Hager.

17 B. Requirements:

18 1. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:

- 19 a. Exterior: Standard weight, stainless steel, 4-1/2 inches (114 mm) high
20 b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

21 2. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:

- 22 a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
23 b. Interior: Heavy weight, steel, 5 inches (127 mm) high

24 3. 2 inches or thicker doors:

- 25 a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
26 b. Interior: Heavy weight, steel, 5 inches (127 mm) high

27 4. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge
28 for each 30 inches (762 mm) of additional door height.

29 5. Where new hinges are specified for existing doors or existing frames, provide new hinges of identical size to
30 hinge preparation present in existing door or existing frame.

31 6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

- 32 a. Steel Hinges: Steel pins
33 b. Non-Ferrous Hinges: Stainless steel pins
34 c. Out-Swinging Exterior Doors: Non-removable pins
35 d. Out-Swinging Interior Lockable Doors: Non-removable pins
36 e. Interior Non-lockable Doors: Non-rising pins

37 7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2
38 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to
39 allow proper degree of opening.

- 1 8. Doors 36 inches (914 mm) wide or less furnish hinges 4 ½ inches (114 mm) high; doors greater than 36
- 2 inches (914 mm) wide furnish hinges 5 inches (127 mm) high, heavy weight or standard weight as specified.
- 3 9. Provide hinges with electrified option where specified. Provide with sufficient number and gage of
- 4 concealed wires to accommodate electric function of specified hardware. Locate electric hinge at second
- 5 hinge from bottom or nearest to electrified locking component.
- 6 10. Provide mortar guard for each electrified hinge specified, unless specified in hollow metal frame
- 7 specification.
- 8 11. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for
- 9 doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762
- 10 mm) of additional door height.

11 CONTINUOUS HINGES

12 A. Aluminum Geared

13 1. Manufacturers:

- 14 a. Scheduled Manufacturer: Ives 224HD/224HD, 210HD/210HD
- 15 b. Acceptable Manufacturers: Hager, Select

16 2. Requirements:

- 17 a. Provide aluminum geared continuous hinges conforming to ANSI A156.25, Grade 2.
- 18 b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from
- 19 6063-T6 aluminum, with 0.25-inch (6 mm) diameter Teflon coated stainless steel hinge pin.
- 20 c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
- 21 d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for
- 22 1,500,000 cycles.
- 23 e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated
- 24 doors by testing agency acceptable to authority having jurisdiction.
- 25 f. Provide aluminum geared continuous hinges with electrified option where specified. Provide with
- 26 sufficient number and gage of concealed wires to accommodate electric function of specified
- 27 hardware.
- 28 g. Install hinges with fasteners supplied by manufacturer.
- 29 h. Provide hinges with symmetrical hole pattern.

30 ELECTRIC POWER TRANSFER

31 A. Manufacturers:

- 32 a. Scheduled Manufacturer: Von Duprin EPT-10
- 33 b. Acceptable Manufacturers: Securitron, ABH

34 B. Provide power transfer with number and gage of wires sufficient to accommodate electric function of specified

35 hardware.

36 C. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with

37 operation of door or other hardware items.

38 FLUSH BOLTS

39 A. Manufacturers:

- 40 1. Scheduled Manufacturer: Ives FB458, FB31P/FB51P, FB41P
- 41 2. Acceptable Manufacturers: Rockwood, Hager

- 1 B. Requirements:
- 2 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless steel face
- 3 plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or
- 4 brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height
- 5 increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-
- 6 proof strikes at each bottom flush bolt.

7 COORDINATORS

- 8 A. Manufacturers:
- 9 1. Scheduled Manufacturer: Ives
- 10 2. Acceptable Manufacturers: Rockwood

- 11 B. Requirements:
- 12 1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires
- 13 synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of
- 14 stop at frame head.
- 15 2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for
- 16 parallel arm door closers and surface vertical rod exit device strikes. Factory-prep coordinators for vertical
- 17 rod devices if required.

18 CYLINDRICAL LOCKS – GRADE 1

- 19 A. Manufacturers and Products:
- 20 1. Scheduled Manufacturer and Product: Schlage ND Series
- 21 2. Acceptable Manufacturers and Products: Sargent 10-Line, Stanley BEST 93K

- 22 B. Requirements:
- 23 1. Provide cylindrical locks conforming to ANSI A156.2 Series 4000, Grade 1. Cylinders: Refer to “KEYING”
- 24 article, herein.
- 25 2. Provide locksets able to withstand 1500 inch pounds of torque applied to locked, outside lever without
- 26 gaining access per ANSI A156.2 Abusive Locked Lever Torque Test and cycle tested to 3 million cycles per
- 27 ANSI A156.2 Cycle Test.
- 28 3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch
- 29 throw. Provide proper latch throw for UL listing at pairs.
- 30 4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
- 31 5. Provide independently operating levers with two external return spring cassettes mounted under roses to
- 32 prevent lever sag.
- 33 6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
- 34 7. Provide electrical options as scheduled.
- 35 8. Lever Trim: Solid cast levers without plastic inserts, and wrought roses on both sides.
- 36 a. Lever Design: Schlage Sparta.

37 AUXILIARY LOCKS

- 38 A. Deadlocks:
- 39 1. Manufacturers and Products:

- 1 a. Scheduled Manufacturer and Product: Schlage L400 series
2 b. Acceptable Manufacturers and Products: Sargent, Stanley BEST
- 3 2. Requirements:
- 4 a. Provide mortise deadlock series conforming to ANSI A156 and function as specified. Cylinders: Refer to
5 "KEYING" article, herein.
6 b. Provide deadlocks with standard 2-3/4 inches (70 mm) backset. Provide deadbolt with full 1 inch (25
7 mm) throw, constructed of stainless steel.
8 c. Provide manufacturer's standard strike.

9 EXIT DEVICES

10 A. Manufacturer and Product:

- 11 a. Scheduled Manufacturer and Product: Von Duprin 99/33 series
12 b. Acceptable Manufacturers and Products: Sargent, Stanley

13 B. Requirements:

- 14 1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1, and UL listed for Panic Exit or Fire Exit Hardware.
15 Cylinders: Refer to "KEYING" article, herein.
16 2. Provide touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to
17 standard architectural finishes to match balance of door hardware.
18 3. Quiet Operation: Incorporate fluid damper or other device that eliminates noise of exit device operation.
19 4. Touchpad: Extend minimum of one half of door width, but not the full length of exit device rail. Provide
20 end-cap with two-point attachment to door. Match exit device finish, stainless steel for US26, US26D,
21 US28, US32, and US32D finishes; and for all other finishes, provide compatible finish to exit device. Provide
22 compression springs in devices, latches, and outside trims or controls; tension springs prohibited.
23 5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other
24 requirements.
25 6. Concealed Vertical Cable Exit Devices: Cable-actuated concealed vertical latch system in two-point and less
26 bottom latch (LBL) configurations. Vertical rods not permitted.
- 27 a. Cable: Stainless steel core wire in stainless steel with polytetrafluoroethylene (Teflon®) liner color-
28 coded to latches and center slides. Conduit and core wire ends snap into latch and center slides
29 without use of tools.
30 b. Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel,
31 with molybdenum disulfide low friction coating.
32 c. Top Latchbolt: Minimum 0.382 inch (10 mm) and greater than 90 degree engagement with strike to
33 prevent door and frame separation under high static load.
34 d. Bottom Latchbolt: Minimum of 0.44 inch (11 mm) engagement with strike.
35 e. Product Cycle Life: 1,000,000 cycles.
36 f. Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages
37 top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
38 g. Latch release does not require separate trigger mechanism.
39 h. Cable and latching system characteristics:
40 1) Assembled prior to being installed in door.
41 2) Installed in door as complete assembly.
42 3) Installed independently of exit device installation, and capable of functioning on door prior to
43 device and trim installation.
44 4) Connected to exit device at single attachment point.
45 5) Bottom latch height adjusted from single point, after system is installed and connected to exit
46 device, while door is hanging
47 6) Latch position altered up and down 2 inches (51 mm) without additional adjustment.
48 7) System may be removed while door is hanging.
49 8) Configure latchbolt mounting: double or single tab mount for steel doors, and wood doors, face
50 mount for aluminum doors, eliminating requirement of tabs.

- 1 9) Provide adjustable exit device to latch center line adjustment. Ensures double tab mounting
2 option for top latch, regardless of exit device centerline.
- 3 7. Provide exit devices with manufacturer's approved strikes.
- 4 8. Provide exit devices cut to door width and height. Locate exit devices at height recommended by exit device
5 manufacturer, allowable by governing building codes, and approved by Architect.
- 6 9. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass
7 trim or molding projects off face of door, provide glass bead kits.
- 8 10. Provide hex-key dogging at non-fire-rated exit devices, unless specified less dogging.
- 9 11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed
10 removable mullion that is removed by use of a keyed cylinder, which is self-locking when re-installed.
- 11 12. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with
12 forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down
13 position when more than 35 pounds of torque are applied, and which can easily be re-set.
- 14 a. Lever Style: Match lever style of locksets.
- 15 b. Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on
16 exterior (secure side) of doors serving rooms considered to be hazardous.
- 17 13. Provide UL labeled fire exit hardware for fire rated openings.
- 18 14. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas,
19 and where noted in hardware sets.
- 20 15. Provide electrical options as scheduled.

21 ELECTRIC STRIKES

22 A. Manufacturers and Products:

- 23 1. Scheduled Manufacturer and Product: Von Duprin 6000 series
- 24 2. Acceptable Manufacturers and Products: HES 1006, 9000 series

25 B. Requirements:

- 26 1. Provide electric strikes designed for use with type of locks shown at each opening.
- 27 2. Provide electric strikes UL Listed as burglary-resistant.
- 28 3. Where required, provide electric strikes UL Listed for fire doors and frames.
- 29 4. Provide fail-secure type electric strikes, unless specified otherwise.
- 30 5. Coordinate voltage and provide transformers and rectifiers for each strike as required.

31 ROLLER LATCHES

32 A. Manufacturers:

- 33 1. Scheduled Manufacturer: Ives
- 34 2. Acceptable Manufacturers: Rockwood, Hager

35 B. Requirements:

- 36 1. Provide roller latches with 4-7/8 inches (124 mm) strike at single doors to fit ANSI frame prep. If dummy
37 levers are used in conjunction with roller latch mount roller latch at a height as to not interfere with proper
38 mounting and height of dummy lever.
- 39 2. Provide roller latches 2-1/4 inches (57 mm) full lip strike at pair doors. Mount roller in top rail of each leaf
40 per manufacturer's template.

1 CYLINDERS

- 2 1. Medeco cylinders and keying provided by owner.

3 DOOR CLOSERS

4 A. Manufacturers and Products:

- 5 1. Scheduled Manufacturer and Product: LCN 4040XP series
6 2. Acceptable Manufacturers and Products: Sargent, Stanley

7 B. Requirements:

- 8 1. Provide door closers certified to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent
9 testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
10 2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder,
11 and full complement bearings at shaft.
12 3. Cylinder Body: 1-1/2 inch (38 mm) diameter, with 11/16 inch (17 mm) diameter double heat-treated pinion
13 journal.
14 4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for
15 temperatures ranging from 120 degrees F to -30 degrees F.
16 5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force
17 as required by accessibility codes and standards.
18 6. Hydraulic Regulation: By tamper-proof, non-critical valves with separate adjustment for latch speed, general
19 speed, and backcheck.
20 7. Provide closers with a solid forged steel main arms and factory assembled heavy-duty forged forearms for
21 parallel arm closers.
22 8. Pressure Relief Valve (PRV) Technology: Not permitted.
23 9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been
24 certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or
25 has special rust inhibitor (SRI).
26 10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details,
27 overhead stops, and other door hardware items interfering with closer mounting.

28 DOOR TRIM

29 A. Manufacturers:

- 30 1. Scheduled Manufacturer: Ives.
31 2. Acceptable Manufacturers: Rockwood, Hager

32 B. Requirements:

- 33 1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and
34 beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to
35 fit.
36 2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient
37 length to span from center to center of each stile. Where required, mount back to back with pull.
38 3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to
39 back with push bar.
40 4. Provide flush pulls as specified. Where required, provide back-to-back mounted model.
41 5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back
42 with push bar.
43 6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled
44 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate,
45 adjust width to fit.

1 7. Provide wire pulls of solid bar stock, diameter and length as scheduled.

2 PROTECTION PLATES

3 A. Manufacturers:

- 4 1. Scheduled Manufacturer: Ives.
5 2. Acceptable Manufacturers: Rockwood, Hager

6 B. Requirements:

- 7 1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick as scheduled.
8 Furnish with sheet metal or wood screws, finished to match plates.
9 2. Sizes of plates:

- 10 a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25
11 mm) less width of door on pairs
12 b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25
13 mm) less width of door on pairs
14 c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch
15 (25 mm) less width of door on pairs

16 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

17 A. Manufacturers:

- 18 1. Scheduled Manufacturers: Glynn-Johnson
19 2. Acceptable Manufacturers: Sargent, Rockwood

20 B. Requirements:

- 21 1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior
22 vestibule single acting doors.
23 2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
24 3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior
25 doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door
26 that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and
27 where conditions do not allow wall stop or floor stop presents tripping hazard.
28 4. Where overhead holders are specified provide friction type at doors without closer and positive type at
29 doors with closer.

30 DOOR STOPS AND HOLDERS

31 A. Manufacturers:

- 32 1. Scheduled Manufacturer: Ives.
33 2. Acceptable Manufacturers: Rockwood, Hager

34 B. Provide door stops at each door leaf:

- 35 1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave
36 type where cylindrical type locks are used.
37 2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
38 3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

1 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

2 A. Manufacturers:

- 3 1. Scheduled Manufacturer: (NGP) National Guard Products.
- 4 2. Acceptable Manufacturers: Pemko, Hager

5 B. Requirements:

- 6 1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems
- 7 (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
- 8 2. Size of thresholds::
 - 9 a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
 - 10 b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
- 11 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal
- 12 strip is easily replaceable and readily available.

13 SILENCERS

14 A. Manufacturers:

- 15 1. Scheduled Manufacturer: Ives.
- 16 2. Acceptable Manufacturers: Rockwood.

17 B. Requirements:

- 18 1. Provide "push-in" type silencers for hollow metal or wood frames.
- 19 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
- 20 3. Omit where gasketing is specified.

21 MAGNETIC HOLDERS

22 A. Manufacturers:

- 23 1. Scheduled Manufacturer: LCN.
- 24 2. Acceptable Manufacturers: Rockwood.

25 B. Requirements:

- 26 1. Provide wall or floor mounted electromagnetic door release as specified with minimum of 25 pounds of
- 27 holding force. Coordination projection of holder and armature with other hardware and wall conditions to
- 28 ensure that door sits parallel to wall when fully open. Wire magnetic holders on fire-rated doors into the
- 29 fire control panel for fail-safe operation.

30 KEY BOXES

31 A. Manufacturers:

- 32 1. Knox Company.

33 B. Requirements:

- 34 1. Key boxes design for storage of building key.

1 2. Knox-box 3200 series. Recessed installation.

2 FINSHES

3 A. Finish: BHMA 626/652 (US26D); except:

- 4 1. Hinges at Exterior Doors: BHMA 630 (US32D)
- 5 2. Continuous Hinges: BHMA 628
- 6 3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
- 7 4. Protection Plates: BHMA 630 (US32D)
- 8 5. Overhead Stops and Holders: BHMA 630 (US32D)
- 9 6. Door Closers: Powder Coat to Match
- 10 7. Wall Stops: BHMA 630 (US32D)
- 11 8. Latch Protectors: BHMA 630 (US32D)
- 12 9. Weather stripping: Clear Anodized Aluminum
- 13 10. Thresholds: Mill Finish Aluminum

14 EXECUTION

15 EXAMINATION

- 16 A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- 17
- 18
- 19 B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- 20
- 21
- 22 C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- 23
- 24 D. Proceed with installation only after unsatisfactory conditions have been corrected.

25 PREPARATION

- 26 A. Where on-site modification of doors and frames is required:
 - 27 1. Remove existing hardware being replaced, tag, and store according to contract documents.
 - 28 2. Field modify and prepare existing door and frame for new hardware being installed.
 - 29 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 30 4. Prepare hardware locations in accordance with:
 - 31 a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - 32
 - 33 b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - 34
 - 35 c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

1 INSTALLATION

- 2 A. Mounting Heights: Mount door hardware units at heights to comply with the following, unless otherwise
3 indicated or required to comply with governing regulations.
- 4 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
5 2. Custom Steel Doors and Frames: HMMA 831.
6 3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- 7 B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only
8 fasteners provided by manufacturer.
- 9 C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed
10 hardware during painting.
- 11 D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for
12 proper installation and operation.
- 13 E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors
14 according to industry standards.
- 15 F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- 16 G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity
17 recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door
18 height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or
19 pivots, are provided.
- 20 H. Lock Cylinders: cylinders provided by owner.
- 21 I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:
- 22 1. Conduit, junction boxes and wire pulls.
23 2. Connections to and from power supplies to electrified hardware.
24 3. Connections to fire/smoke alarm system and smoke evacuation system.
25 4. Connection of wire to door position switches and wire runs to central room or area, as directed by
26 Architect.
27 5. Testing and labeling wires with Architect's opening number.
- 28 J. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway
29 doors from corridors. Closers shall not be visible in corridors, lobbies and other public spaces unless approved by
30 Architect.
- 31 K. Closer/Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of
32 stairway doors.
- 33 L. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in
34 equipment room, or alternate location as directed by Architect.
- 35 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- 36 M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section
37 "Joint Sealants."
- 38 N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do
39 not mount floor stops where they may impede traffic or present tripping hazard.

- 1 O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- 2 P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- 3 Q. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

4 FIELD QUALITY CONTROL

- 5 A. Architectural Hardware Consultant: Engage qualified independent Architectural Hardware Consultant to
- 6 perform inspections and to prepare inspection reports.
- 7 1. Architectural Hardware Consultant will inspect door hardware and state in each report whether installed
- 8 work complies with or deviates from requirements, including whether door hardware is properly installed
- 9 and adjusted.

10 ADJUSTING

- 11 A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper
- 12 operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door
- 13 control devices to compensate for final operation of heating and ventilating equipment and to comply with
- 14 referenced accessibility requirements.
- 15 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open
- 16 position of 30 degrees.
- 17 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- 18 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of
- 19 authorities having jurisdiction.
- 20 B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural
- 21 Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating
- 22 forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

23 CLEANING AND PROTECTION

- 24 A. Clean adjacent surfaces soiled by door hardware installation.
- 25 B. Clean operating items as necessary to restore proper function and finish.
- 26 C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration
- 27 at time of Substantial Completion.

28 DEMONSTRATION

- 29 A. Provide training for Owner's maintenance personnel to adjust, operate, and maintain door hardware and door
- 30 hardware finishes. Refer to Division 01 Section "Demonstration and Training."

31 DOOR HARDWARE SCHEDULE

- 32 A. Locksets, exit devices, and other hardware items are referenced in the following hardware sets for series, type
- 33 and function. Refer to the above-specifications for special features, options, cylinders/keying, and other
- 34 requirements.

1 B. Hardware Sets:
2

3 **SET AL1**

4	1	EA	CONTINUOUS HINGE	780-112HD	CLR HAGER
5	1	EA	RIM EXIT DEVICE	CD99NL	626 VON DUPRIN
6	2	EA	CYLINDER	BY OWNER	
7	1	EA	AUTOMATIC OPERATOR	STANLEY MAGIC FORCE	689 STANLEY
8	2	EA	ACTUATOR	AS REQUIRED	689 STANLEY
9	1	EA	ELECTRIC STRIKE	9600	630 HES

10
11 *CARD READER BY OTHERS*

12
13 *OPERATIONAL DESCRIPTION: OPENING NORMALLY LOCKED AND CLOSED AND ELECTRIC STRIKE SECURED. DURING*
14 *REGULAR BUSINESS HOURS, ELECTRIC STRIKE SHALL BE UNSECURED, ALLOWING ENTRY. ACCESS VIA AUTHORIZED USE*
15 *OF CARD READER ALLOWED AT TIMES AS PROGRAMMED BY OWNER. IN THE EVENT OF A POWER OUTAGE, THE*
16 *ELECTRIC STRIKE SHALL REMAIN SECURED.*

17
18 **SET AL2**

19	1	EA	CONTINUOUS HINGE	780-112HD	CLR HAGER
20	1	EA	RIM EXIT DEVICE	CD99NL	626 VON DUPRIN
21	2	EA	CYLINDER	BY OWNER	
22	1	EA	AUTOMATIC OPERATOR	STANLEY MAGIC FORCE	689 STANLEY
23	2	EA	ACTUATOR	AS REQUIRED	689 STANLEY
24	1	EA	THRESHOLD	413S	MIL HAGER
25	1	EA	ELECTRIC STRIKE	9600	630 HES

26
27 *LOCK DOWN BUTTON BY OTHERS*

28
29 *OPERATIONAL DESCRIPTION: EXIT DEVICE NORMALLY LOCKED AND DOOR CLOSED. ELECTRIC STRIKE SHALL NORMALLY*
30 *BE DISENGAGED ALLOWING ENTRY TO THE VESTIBULE. DURING AN EMERGENCY SITUATION, ACTIVATION OF THE LOCK*
31 *DOWN BUTTON SHALL CAUSE ELECTRIC STRIKE TO ENGAGE, LOCKING OUT ENTRY FROM THE EXTERIOR. EXTERIOR*
32 *ENTRY SHALL BE ALLOWED AT ANY TIME WITH USE OF AUTHORIZED KEY.*

33
34 **SET AL3**

35	1	EA	CONTINUOUS HINGE	780-112HD	CLR HAGER
36	1	EA	RIM EXIT DEVICE	CD99NL	626 VON DUPRIN
37	2	EA	CYLINDER	BY OWNER	
38	1	EA	CLOSER	4040XP EDA	689 LCN
39	1	EA	OVERHEAD STOP	100S	630 GJ
40	1	EA	THRESHOLD	413S	MIL HAGER

41
42 **SET AL4**

43	1	EA	CONTINUOUS HINGE	780-112HD w/EPT PREP	CLR HAGER
44	1	EA	ELECTRIC POWER TRANSFER	EPT-10 CON	628 VON DUPRIN
45	1	EA	RIM EXIT DEVICE w/DELAYED	CX99NL CON	626 VON DUPRIN
46			EGRESS		
47	2	EA	CYLINDER	BY OWNER	
48	1	EA	CLOSER	4040XP EDA	689 LCN
49	1	EA	OVERHEAD STOP	100S	630 GJ
50	1	EA	THRESHOLD	410S	MIL HAGER
51	1	EA	SWEEP	750SN	CLR HAGER
52	1	SET	SEALS	891SV	MIL HAGER
53	1	EA	RAIN DRIP	810S	MIL HAGER
54	1	EA	ELECTRIC STRIKE	9600	630 HES

55
56 *CARD READERS BY OTHERS*
57

1 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. FROM THE INTERIOR, EGRESS IS DELAYED VIA THE
2 CHEXIT DELAYED EGRESS SYSTEM. AUTHORIZED EGRESS SHALL BE ALLOWED VIA USE OF CARD ACCESS SYSTEM. FROM THE
3 EXTERIOR, AUTHORIZED ENTRY IS ALLOWED VIA THE CARD ACCESS SYSTEM.
4

5 **SET 1A**

6	EA	HINGES	AS REQUIRED	652
7	1 EA	STOREROOM w/DEADBOLT	L9480L x L583-363	626 SCHLAGE
8	1 EA	CYLINDER	BY OWNER	
9	1 EA	CLOSER	4040XP EDA	689 LCN
10	1 EA	OVERHEAD STOP	100S	630 GJ
11	1 EA	KICKPLATE	10" x 2" LDW	630 IVES
12	1 EA	ELECTRIC STRIKE	1006 DB	630 HES

13
14 CARD READER BY OTHERS
15

16 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD
17 ACCESS SYSTEM. ACCESS CONTROL SYSTEM MAY ALSO BE PROGRAMMED TO DISENGAGE THE ELECTRIC STRIKE WHEN THE
18 ROOM IS IN USE. DEADBOLT VIA THUMB TURN CAN BE USED AT ANY TIME TO OVERRIDE ELECTRIC STRIKE AND LOCK THE
19 DOOR.
20

21 **SET 2A**

22	1 EA	CONTINUOUS HINGE	780-224HD	CLR HAGER
23	1 EA	STOREROOM LOCK	ND80LD	626 SCHLAGE
24	1 EA	CYLINDER	BY OWNER	
25	1 EA	CLOSER	4040XP EDA	689 LCN
26	1 EA	WALL STOP	409	630 ROCKWOOD
27	1 EA	KICKPLATE	10" x 2" LDW	630 IVES
28	1 EA	ELECTRIC STRIKE	1006 LB	630 HES

29
30 CARD READER BY OTHERS
31

32 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD
33 ACCESS SYSTEM.
34

35 **SET 2B**

36	EA	HINGES	AS REQUIRED	652
37	1 EA	STOREROOM LOCK	ND80LD	626 SCHLAGE
38	1 EA	CYLINDER	BY OWNER	
39	1 EA	CLOSER	4040XP	689 LCN
40	1 EA	WALL STOP	409	630 ROCKWOOD
41	1 EA	KICKPLATE	10" x 2" LDW	630 IVES
42	1 EA	ELECTRIC STRIKE	1006 LB	630 HES

43
44 CARD READER BY OTHERS
45

46 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD
47 ACCESS SYSTEM.
48

49 **SET 2C**

50	1 EA	CONTINUOUS HINGE	780-224HD	CLR HAGER
51	1 EA	STOREROOM LOCK	ND80LD	626 SCHLAGE
52	1 EA	CYLINDER	BY OWNER	
53	1 EA	CLOSER	4040XP x ST1630 x 4040XP-18TJ	689 LCN
54	1 EA	OVERHEAD STOP	100S	630 GJ
55	1 EA	KICKPLATE	10" x 2" LDW	630 IVES
56	1 EA	ELECTRIC STRIKE	1006 LB	630 HES

57
58 CARD READER BY OTHERS

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OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD ACCESS SYSTEM.

SET 2D

EA	HINGES	AS REQUIRED	652
1 EA	STOREROOM LOCK	ND80LD	626 SCHLAGE
1 EA	CYLINDER	BY OWNER	
1 EA	CLOSER	4040XP x ST1630 x 4040XP-18TJ	689 LCN
1 EA	OVERHEAD HOLDER	100H	630 GJ
1 EA	KICKPLATE	10" x 2" LDW	630 IVES
1 EA	ELECTRIC STRIKE	1006 LB	630 HES

CARD READER BY OTHERS

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD ACCESS SYSTEM.

SET 3A

EA	HINGES	AS REQUIRED	652
1 EA	PRIVACY LATCH	ND40S	626 SCHLAGE
1 EA	WALL STOP	409	630 ROCKWOOD

SET 4A

EA	HINGES	AS REQUIRED	652
2 EA	ROLLER LATCH	RL30	626 IVES
2 EA	FLUSH PULL	BF97L	630 ROCKWOOD
2 EA	WALL STOP	409	630 ROCKWOOD

SET 5A

EA	HINGES	AS REQUIRED	652
1 EA	CLASSROOM LOCK	ND70LD	626 SCHLAGE
1 EA	CYLINDER	BY OWNER	
1 EA	MANUAL FLUSH BOLT	FB458 (TOP BOLT ONLY)	626 IVES
2 EA	WALL STOP	409	630 ROCKWOOD

SET 6A

EA	HINGES	AS REQUIRED	652
1 EA	OFFICE LOCK	ND50LD	626 SCHLAGE
1 EA	CYLINDER	BY OWNER	
1 EA	CLOSER	4040XP	689 LCN
1 EA	WALL STOP	409	630 ROCKWOOD
1 EA	KICKPLATE	10" x 2" LDW	630 IVES

SET 6B

EA	HINGES	AS REQUIRED	652
1 EA	OFFICE LOCK	ND50LD	626 SCHLAGE
1 EA	CYLINDER	BY OWNER	
1 EA	WALL STOP	409	630 ROCKWOOD

SET 6C

EA	HINGES	AS REQUIRED	652
1 EA	OFFICE LOCK	ND50LD	626 SCHLAGE
1 EA	CYLINDER	BY OWNER	
1 EA	OVERHEAD STOP	100S	630 GJ

SET 7A

EA	HINGES	AS REQUIRED	652
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1	1	EA	STOREROOM LOCK	ND80LD	626	SCHLAGE
2	1	EA	CYLINDER	BY OWNER		
3	1	EA	WALL STOP	409	630	ROCKWOOD
4						
5			SET 7B			
6		EA	HINGES	AS REQUIRED	652	
7	1	EA	STOREROOM LOCK	ND80LD	626	SCHLAGE
8	1	EA	CYLINDER	BY OWNER		
9	1	EA	CLOSER	4040XP	689	LCN
10	1	EA	WALL STOP	409	630	ROCKWOOD
11	1	EA	KICKPLATE	10" x 2" LDW	630	IVES
12						
13			SET 7C			
14	2	EA	CONTINUOUS HINGE	780-224HD	CLR	HAGER
15	1	EA	STOREROOM LOCK	ND80LD	626	SCHLAGE
16	1	EA	CYLINDER	BY OWNER		
17	1	PR	AUTOMATIC FLUSH BOLTS	FB51P	626	IVES
18	1	EA	DUST PROOF STRIKE	DP1	626	IVES
19	1	EA	COORDINATOR w/FILLER BAR	CORXX x FLXX x MOUNTING BRACKETS	628	IVES
20	2	EA	CLOSER	4040XP EDA	689	LCN
21	2	EA	WALL STOP	409	630	ROCKWOOD
22	2	EA	KICKPLATE	10" x 2" LDW	630	IVES
23	1	EA	THRESHOLD	410S	MIL	HAGER
24	2	EA	SWEEP	750SN	CLR	HAGER
25	1	SET	SEALS	891SV	MIL	HAGER
26						
27			SET 8A			
28		EA	HINGES	AS REQUIRED	652	
29	1	EA	PUSH PLATE	70C	630	ROCKWOOD
30	1	EA	PULL w/PLATE	BF108 x 70C	630	ROCKWOOD
31	1	EA	CLOSER	4040XP x ST1630 x 4040XP-18TJ	689	LCN
32	1	EA	OVERHEAD STOP	100S	630	GJ
33	1	EA	KICKPLATE	10" x 2" LDW	630	IVES
34						
35			SET 8B			
36		EA	HINGES	AS REQUIRED	652	
37	1	EA	PUSH PLATE	70C	630	ROCKWOOD
38	1	EA	PULL w/PLATE	BF108 x 70C	630	ROCKWOOD
39	1	EA	CLOSER	4040XP	689	LCN
40	1	EA	WALL STOP	409	630	ROCKWOOD
41	1	EA	KICKPLATE	10" x 2" LDW	630	IVES
42						
43			SET 8C			
44		EA	HINGES	AS REQUIRED	652	
45	1	EA	PUSH PLATE	70C	630	ROCKWOOD
46	1	EA	PULL w/PLATE	BF108 x 70C	630	ROCKWOOD
47	1	EA	CLOSER w/HOLDER	4040XP H	689	LCN
48	1	EA	WALL STOP	409	630	ROCKWOOD
49	1	EA	KICKPLATE	10" x 2" LDW	630	IVES
50						
51			SET 8D			
52		EA	HINGES	AS REQUIRED	652	
53	1	EA	PUSH PLATE	70C	630	ROCKWOOD
54	1	EA	PULL w/PLATE	BF108 x 70C	630	ROCKWOOD
55	1	EA	CLOSER	4040XP	689	LCN
56	1	EA	OVERHEAD STOP	100S	630	GJ
57	1	EA	KICKPLATE	10" x 2" LDW	630	IVES
58						

1		<u>SET 9A</u>		
2		EA HINGES	AS REQUIRED	652
3	1	EA PASSAGE LATCH	ND10S	626 SCHLAGE
4	1	EA OVERHEAD STOP	100S	630 GJ
5				
6		<u>SET 9B</u>		
7		EA HINGES	AS REQUIRED	652
8	1	EA PASSAGE LATCH	ND10S	626 SCHLAGE
9	1	EA WALL STOP	409	630 ROCKWOOD
10				
11		<u>SET 9C</u>		
12		EA HINGES	AS REQUIRED	652
13	1	EA PASSAGE LATCH	ND10S	626 SCHLAGE
14	1	EA MANUAL FLUSH BOLT	FB458 (TOP BOLT ONLY)	626 IVES
15	1	EA CLOSER w/HOLDER	4040XP H	689 LCN
16	2	EA WALL STOP	409	630 ROCKWOOD
17	2	EA KICKPLATE	10" x 2" LDW	630 IVES
18				
19		<u>SET 10A</u>		
20	1	EA CONTINUOUS HINGE	780-112HD	CLR HAGER
21	1	EA RIM EXIT DEVICE	99EO x LESS DOGGING	626 VON DUPRIN
22	1	EA CLOSER	4040XP EDA	689 LCN
23	1	EA OVERHEAD STOP	100S	630 GJ
24	1	EA KICKPLATE	10" x 2" LDW	630 IVES
25	1	EA THRESHOLD	410S	MIL HAGER
26	1	EA SWEEP	750SN	CLR HAGER
27	1	SET SEALS	891SV	MIL HAGER
28	1	EA RAIN DRIP	810S	MIL HAGER
29				
30		<u>SET 10B</u>		
31	1	EA CONTINUOUS HINGE	780-112HD x EPT PREP	CLR HAGER
32	1	EA ELECTRIC POWER TRANSFER	EPT-10 CON	628 VON DUPRIN
33	1	EA RIM FIRE EXIT DEVICE w/ELEC.	99L-F x E996L FAIL SAFE CON	626 VON DUPRIN
34		LEVER		
35	1	EA CYLINDER	BY OWNER	
36	1	EA CLOSER	4040XP EDA	689 LCN
37	1	EA OVERHEAD STOP	100S	630 GJ
38	1	EA KICKPLATE	10" x 2" LDW	630 IVES
39	1	EA THRESHOLD	410S	MIL HAGER
40	1	EA SWEEP	750SN	CLR HAGER
41	1	SET SEALS	891SV	MIL HAGER
42				
43		<i>CARD READER BY OTHERS</i>		
44				
45		<i>OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD</i>		
46		<i>ACCESS SYSTEM. ELECTRIFIED TRIM SHALL NORMALLY BE IN THE POWERED STATE, MAINTAINING SECURITY OF THE</i>		
47		<i>OPENING. IN THE EVENT OF A FIRE OR POWER FAILURE, THE ELECTRIFIED LEVER TRIM SHALL DISENGAGE AND ALLOW</i>		
48		<i>ENTRY.</i>		
49				
50		<u>SET 10C</u>		
51	1	EA CONTINUOUS HINGE	780-112HD	CLR HAGER
52	1	EA RIM FIRE EXIT DEVICE	99NL-F	626 VON DUPRIN
53	1	EA CYLINDER	BY OWNER	
54	1	EA CLOSER	4040XP EDA	689 LCN
55	1	EA OVERHEAD STOP	100S	630 GJ
56	1	EA KICKPLATE	10" x 2" LDW	630 IVES
57	1	EA THRESHOLD	410S	MIL HAGER
58	1	EA SWEEP	750SN	CLR HAGER

1 1 SET SEALS 891SV MIL HAGER
2 1 EA ELECTRIC STRIKE 9600 626 HES

3
4 CARD READER BY OTHERS

5
6 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD
7 ACCESS SYSTEM.

8
9 **SET 10D**

10 1 EA CONTINUOUS HINGE 780-112HD CLR HAGER
11 1 EA RIM EXIT DEVICE 99L-BE 626 VON DUPRIN
12 1 EA CLOSER 4040XP EDA 689 LCN
13 1 EA OVERHEAD STOP 100S 630 GJ
14 1 EA KICKPLATE 10" x 2" LDW 630 IVES

15
16 **SET 10E**

17 EA HINGES AS REQUIRED 652
18 1 EA RIM FIRE EXIT DEVICE 99L-BE-F 626 VON DUPRIN
19 1 EA CLOSER 4040XP 689 LCN
20 1 EA WALL STOP 409 630 ROCKWOOD
21 1 EA KICKPLATE 10" x 2" LDW 630 IVES

22
23 **SET 10F**

24 1 EA CONTINUOUS HINGE 780-112HD x EPT PREP CLR HAGER
25 1 EA ELECTRIC POWER TRANSFER EPT-10 CON 628 VON DUPRIN
26 1 EA RIM EXIT DEVICE 99NL x LESS DOGGING 626 VON DUPRIN
27 1 EA CYLINDER BY OWNER
28 1 EA CLOSER 4040XP EDA 689 LCN
29 1 EA OVERHEAD STOP 100S 630 GJ
30 1 EA KICKPLATE 10" x 2" LDW 630 IVES
31 1 EA THRESHOLD 410S MIL HAGER
32 1 EA SWEEP 750SN CLR HAGER
33 1 SET SEALS 891SV MIL HAGER
34 1 EA ELECTRIC STRIKE 9600 626 HES

35
36 CARD READER BY OTHERS

37
38 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD
39 ACCESS SYSTEM.

40
41 **SET 11A**

42 1 EA CONTINUOUS HINGE 780-224HD CLR HAGER
43 1 EA STOREROOM LOCK ND80LD 626 SCHLAGE
44 1 EA CYLINDER BY OWNER
45 1 EA CLOSER 4040XP EDA 689 LCN
46 1 EA OVERHEAD STOP 100S 630 GJ
47 1 EA KICKPLATE 10" x 2" LDW 630 IVES
48 1 EA LATCH GUARD LG14 630 IVES
49 1 EA THRESHOLD 410S MIL HAGER
50 1 EA SWEEP 750SN CLR HAGER
51 1 SET SEALS 891SV MIL HAGER
52 1 EA RAIN DRIP 810S MIL HAGER
53 1 EA ELECTRIC STRIKE 1006 LB 630 HES

54
55 CARD READER BY OTHERS

56
57 OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD
58 ACCESS SYSTEM.

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SET 12A

1	EA	CONTINUOUS HINGE	780-224HD	CLR HAGER
1	EA	INSTITUTIONAL LOCK	ND82LD	626 SCHLAGE
2	EA	CYLINDER	BY OWNER	
1	EA	CLOSER	4040XP EDA	689 LCN
1	EA	WALL STOP	409	630 ROCKWOOD
1	EA	KICKPLATE	10" x 2" LDW	630 IVES
1	EA	ELECTRIC STRIKE	1006 LB	630 HES

CARD READER BY OTHERS

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ENTRY ALLOWED VIA AUTHORIZED USE OF CARD ACCESS SYSTEM.

End Of Section

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1 SECTION 088000 - GLAZING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes:

- 8 1. Glass for **windows, doors, interior borrowed lites, and storefront framing.**
9 2. Polycarbonate glazing.
10 3. Glazing sealants and accessories.

- 11 B. Related Requirements:

- 12 1. Section 088300 "Mirrors."

13 1.3 DEFINITIONS

- 14 A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing
15 publications.

- 16 B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

- 17 C. IBC: International Building Code.

- 18 D. Interspace: Space between lites of an insulating-glass unit.

19 1.4 COORDINATION

- 20 A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and
21 adequate sealant thicknesses, with reasonable tolerances.

22 1.5 PREINSTALLATION MEETINGS

- 23 A. Preinstallation Conference: Conduct conference at **Project site.**

- 24 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel,
25 equipment, and facilities needed to make progress and avoid delays.
26 2. Review temporary protection requirements for glazing during and after installation.

27 1.6 ACTION SUBMITTALS

- 28 A. Product Data: For each type of product.

- 1 B. Sustainable Design Submittals:
2
3 1. Product Data for Credit EQ 4.1: For glazing sealants used inside of the weatherproofing system, including
4 printed statement of VOC content.
5 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
6 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
7 product having recycled content.
8 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
9 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
10 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
11 material, and fraction by weight that is considered regional.
- 12 C. Glass Samples: For each type of **glass product other than clear monolithic vision glass; 12 inches (300 mm)** square.
13 1. Insulating glass.
14 2. Polycarbonate glazing
- 15 D. Glazing Accessory Samples: For **colored spacers**, in **12-inch (300-mm)** lengths.
- 16 E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations
17 indicated on Drawings.
- 18 F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria,
19 including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 20 1.7 INFORMATIONAL SUBMITTALS
- 21 A. Qualification Data: For **Installer**.
- 22 B. Product Certificates: For glass.
- 23 C. Product Test Reports: For **insulating glass**, for tests performed by a qualified testing agency.
24 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-
25 month period.
- 26 D. Preconstruction adhesion and compatibility test report.
- 27 E. Sample Warranties: For special warranties.
- 28 1.8 QUALITY ASSURANCE
- 29 A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-
30 glass manufacturer who is approved by coated-glass manufacturer.
- 31 B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the
32 National Glass Association's Certified Glass Installer Program.
- 33 C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1
34 Certification Agency Program.

- 1 1.9 DELIVERY, STORAGE, AND HANDLING
- 2 A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing
3 materials from condensation, temperature changes, direct exposure to sun, or other causes.
- 4 1.10 FIELD CONDITIONS
- 5 A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are
6 outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain,
7 frost, condensation, or other causes.
- 8 1.11 WARRANTY
- 9 A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that
10 deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from
11 normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to
12 manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in
13 coating.
- 14 1. Warranty Period: **10** years from date of Substantial Completion.
- 15 B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that
16 deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal
17 under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to
18 manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on
19 interior surfaces of glass.
- 20 1. Warranty Period: **10** years from date of Substantial Completion.
- 21 PART 2 - PRODUCTS
- 22 2.1 MANUFACTURERS
- 23 A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into
24 the Work include, but are not limited to, the following:
25
- 26 1. Oldcastle Glass
27 2. Cardinal Glass
28 3. Guardian Industries
29 4. Pilkington
30 5. PPG Industries
31 6. Visteon Float Glass
- 32 B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- 33 1. Obtain tinted glass from single source from single manufacturer.
34 2. Obtain reflective-coated glass from single source from single manufacturer.
- 35 C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product
36 and installation method.

- 1 2.2 PERFORMANCE REQUIREMENTS
- 2 A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where
3 applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture,
4 fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing
5 materials; or other defects in construction.
- 6 B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements,"
7 to design glazing.
- 8 C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions
9 indicated determined according to the IBC and ASTM E 1300.
- 10 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7,
11 based on heights above grade indicated on Drawings.
- 12 a. Basic Wind Speed: **90 mph (40 m/s)**.
13 b. Importance Factor: **1.15**.
14 c. Exposure Category: **B**.
- 15 2. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical,
16 design glass for a probability of breakage not greater than 0.001.
- 17 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design
18 wind pressure to not more than 1/50 times the short-side length or **1 inch (25 mm)**, whichever is less.
- 19 D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- 20 E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in
21 manufacturer's published test data, based on procedures indicated below:
- 22 1. For monolithic-glass lites, properties are based on units with lites **6 mm thick**.
23 2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each
24 lite.
25 3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer
26 program, expressed as **Btu/sq. ft. x h x deg F (W/sq. m x K)**.
27 4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and
28 based on LBL's WINDOW 5.2 computer program.
29 5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.
- 30 2.3 GLASS PRODUCTS, GENERAL
- 31 A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations
32 below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise
33 defined in this Section or in referenced standards.
- 34 1. GANA Publications: "Glazing Manual."
35 2. AAMA Publications: AAMA GD5G-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing
36 Guidelines."
37 3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
38 4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed
39 Insulating Glass Units for Commercial and Residential Use."
- 40 B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the
41 **SGCC or another certification agency acceptable to authorities having jurisdiction**. Label shall indicate
42 manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- 1 C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of
2 units with appropriate certification label of IGCC.
- 3 D. Thickness: Where glass thickness is indicated, it is a minimum. **Provide glass that complies with performance
4 requirements and is not less than the thickness indicated.**
- 5 1. Minimum Glass Thickness for Exterior Lites: **6 mm.**
- 6 E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or
7 fully tempered float glass **as needed to comply with "Performance Requirements" Article.** Where heat-
8 strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass **as needed
9 to comply with "Performance Requirements" Article.** Where fully tempered float glass is indicated, provide fully
10 tempered float glass.

11 2.4 GLASS PRODUCTS

- 12 A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- 13 B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise
14 indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- 15 C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless
16 otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

17 2.5 INSULATING GLASS

- 18 A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated
19 interspace, qualified according to ASTM E 2190.
- 20 1. Sealing System: Dual seal, with **polyisobutylene and silicone** primary and secondary sealants.
21 2. Perimeter Spacer: **Nonmetallic "warm edge" spacer.**
22 3. Desiccant: Molecular sieve or silica gel, or a blend of both.

23 2.6 GLAZING SEALANTS

- 24 A. General:
- 25 1. Compatibility: Compatible with one another and with other materials they contact, including glass products,
26 seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as
27 demonstrated by sealant manufacturer based on testing and field experience.
- 28 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants
29 suitable for applications indicated and for conditions existing at time of installation.
- 30 3. Colors of Exposed Glazing Sealants: **As selected by Architect from manufacturer's full range.**

31 2.7 GLAZING TAPES

- 32 A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and
33 nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape
34 and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products
35 indicated below:
- 36 1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
37 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

- 1 B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and
2 complying with AAMA 800 for the following types:
- 3 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
4 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid
5 sealant.

6 2.8 MISCELLANEOUS GLAZING MATERIALS

- 7 A. General: Provide products of material, size, and shape complying with referenced glazing standard, with
8 requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven
9 record of compatibility with surfaces contacted in installation.
- 10 B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- 11 C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- 12 D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass
13 lites in place for installation indicated.
- 14 E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

15 2.9 FABRICATION OF GLAZING UNITS

- 16 A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge
17 and surface conditions, and bite complying with written instructions of product manufacturer and referenced
18 glazing publications, to comply with system performance requirements.
- 19 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing
20 members and glazing components.
- 21 a. Temperature Change: **120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.**

22 PART 3 - EXECUTION

23 3.1 EXAMINATION

- 24 A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
- 25 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
26 2. Presence and functioning of weep systems.
27 3. Minimum required face and edge clearances.
28 4. Effective sealing between joints of glass-framing members.
- 29 B. Proceed with installation only after unsatisfactory conditions have been corrected.

30 3.2 PREPARATION

- 31 A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not
32 firmly bonded to substrates.

1 B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and
2 interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3 3.3 GLAZING, GENERAL

4 A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials,
5 unless more stringent requirements are indicated, including those in referenced glazing publications.

6 B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and
7 legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when
8 installed, could weaken glass, impair performance, or impair appearance.

9 C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

10 D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless
11 otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

12 E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

13 F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).

14 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and
15 spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have
16 demonstrated ability to maintain required face clearances and to comply with system performance
17 requirements.

18 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With
19 glazing tape, use thickness slightly less than final compressed thickness of tape.

20 G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as
21 recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

22 H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

23 I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

24 3.4 GLAZING MATERIALS, POLYCARBONATE

25 A. Compatibility: Select material with proven record of compatibility with polycarbonate sheet.

26 B. Glazing Tape: Performed butyl, NAAMM #55-1B-6B 1 with integral resilient tube spacing device; 10-15 Shore A
27 hardness; cooled on release paper; color as later selected by Architect.

28 C. Setting Blocks: Neoprene, EPDM or silicone blocks, as required for compatibility with glazing sealants, 70-90 Shore A
29 durometer hardness, 4 inch long x 3/8 inch wide x 1/4 inch thick.

30 D. Spacers: Neoprene, EPDM or silicone blocks, or continuous extrusions, as required for compatibility with glazing
31 sealants; 40-50 Shore A durometer hardness; of size and shape recommended by glass and sealant manufacturer.

32 E. Edge Blocks: Neoprene blocks as required for compatibility with glazing sealant, of size and hardness required to
33 limit lateral movement of glass.

- 1 3.5 TAPE GLAZING
- 2 A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude
3 slightly above sightline of stops.
- 4 B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit
5 opening.
- 6 C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints
7 by applying tapes to jambs, then to heads and sills.
- 8 D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes
9 with compatible sealant approved by tape manufacturer.
- 10 E. Do not remove release paper from tape until right before each glazing unit is installed.
- 11 F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression
12 gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners
13 and work toward centers of openings.
- 14 3.6 GASKET GLAZING (DRY)
- 15 A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance
16 for stretch during installation.
- 17 B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut
18 and bonded together at corners.
- 19 C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against
20 soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces
21 of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to
22 produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant
23 recommended by gasket manufacturer.
- 24 D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against
25 soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly
26 to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in
27 glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- 28 E. Install gaskets so they protrude past face of glazing stops.
- 29 3.7 SEALANT GLAZING (WET)
- 30 A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing
31 stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep
32 systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of
33 installed sealant relative to edge clearance for optimum sealant performance.
- 34 B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass
35 and channel surfaces.
- 36 C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

- 1 3.8 CLEANING AND PROTECTION
- 2 A. Immediately after installation remove nonpermanent labels and clean surfaces.
- 3 B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass
4 surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during
5 construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
- 6 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances
7 immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be
8 cleaned without damage to coatings.
- 9 C. Remove and replace glass that is damaged during construction period.
- 10 D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish
11 date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

12 3.9 MONOLITHIC GLASS SCHEDULE

- 13 A. Glass Type **GL-5**: Clear **fully tempered** float glass.
- 14
- 15 1. Minimum Thickness: **6 mm**.
- 16 2. Safety glazing required.

17 3.10 INSULATING GLASS SCHEDULE

- 18 A. Glass Type **GL-1**: Low-E-coated, clear insulating glass.
- 19 1. Overall Unit Thickness: **1 inch (25 mm)**.
- 20 2. Minimum Thickness of Each Glass Lite: **6 mm**.
- 21 3. Outdoor Lite: **Heat-strengthened** float glass.
- 22 4. Interspace Content: **Argon**.
- 23 5. Indoor Lite: **Heat-strengthened** float glass.
- 24 6. Low-E Coating: **Sputtered on second** surface.
- 25 7. Winter Nighttime U-Factor: 0.20 maximum.
- 26 8. Summer Daytime U-Factor: 0.17 maximum.
- 27 9. Visible Light Transmittance: 60 percent minimum.
- 28 10. Solar Heat Gain Coefficient: 0.25 maximum.
- 29 B. Glass Type **GL-2**: Low-E-coated, clear insulating glass.
- 30 1. Overall Unit Thickness: **1 inch (25 mm)**.
- 31 2. Minimum Thickness of Each Glass Lite: **6 mm**.
- 32 3. Outdoor Lite: Fully tempered float glass.
- 33 4. Interspace Content: **Argon**.
- 34 5. Indoor Lite: Fully tempered float glass.
- 35 6. Low-E Coating: **Sputtered on second** surface.
- 36 7. Winter Nighttime U-Factor: 0.20 maximum.
- 37 8. Summer Daytime U-Factor: 0.17 maximum.
- 38 9. Visible Light Transmittance: 60 percent minimum.
- 39 10. Solar Heat Gain Coefficient: 0.25 maximum.
- 40 11. Safety glazing required.
- 41 C. Glass Type **GL-3**: Low-E-coated, light diffusing glass.

- 1 1. Basis-of-Design Product: Solera Low-E
- 2 2. Overall Unit Thickness: **1 inch (25 mm)**.
- 3 3. Minimum Thickness of Each Glass Lite: **6 mm**.
- 4 4. Outdoor Lite: **Heat-strengthened** float glass.
- 5 5. Interspace Content: **Air**.
- 6 6. Indoor Lite: **Heat-strengthened** float glass.
- 7 7. Low-E Coating: Solera low-e coating on second surface.
- 8 8. Winter Nighttime U-Factor: 0.20 maximum.
- 9 9. Summer Daytime U-Factor: 0.17 maximum.
- 10 10. Visible Light Transmittance: 40 percent minimum.
- 11 11. Solar Heat Gain Coefficient: 0.35.

12 3.11 ACRYLIC GLAZING TYPES

13 A. Glass Type GL-4: High impact, abrasion resistant polycarbonate

- 14
- 15 1. Basis-of-Design Product: Subject to compliance with requirements, provide SABIC Innovative Plastics, Lexan
- 16 MR10 or comparable product.
- 17 2. Light Transmission: 88% @ 1/8 thickness.
- 18 3. Thickness: 1/2 inch.
- 19 4. UL 972 – Burglary-Resistant glazing.
- 20 5. Hazing resistance: Taber Abrasion 100 cycles CS 10F
- 21 a. ASTM D 1044 Z26.1.
- 22 1) Result 1-3.

23 3.12 SINGLE GLASS SCHEDULE

24 A. Glass Type GL-5: Clear fully tempered float glass.

- 25
- 26 1. Thickness: 6.0 mm. (GL-7SC: 12.0 mm)
- 27 2. Provide safety glazing labeling.

28 END OF SECTION 088000

1 SECTION 088300 - MIRRORS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes the following types of silvered flat glass mirrors:

- 8 1. **Laminated** glass mirrors qualifying as safety glazing.

9 1.3 ACTION SUBMITTALS

- 10 A. Product Data: For each type of product.

- 11 B. Sustainable Design Submittal.

- 12
13 1. Product Data for Credit EQ 4.1: For glazing sealants, including printed statement of VOC content and
14 chemical components.
15 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
16 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
17 product having recycled content.
18 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
19 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
20 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
21 material, and fraction by weight that is considered regional.

- 22 C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

- 23 D. Sample Warranty: For special warranty.

24 1.4 DELIVERY, STORAGE, AND HANDLING

- 25 A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to
26 mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

- 27 B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to
28 prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store
29 indoors.

30 1.5 FIELD CONDITIONS

- 31 A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are
32 maintained at levels indicated for final occupancy.

- 1 1.6 WARRANTY
- 2 A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period.
3 Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage
4 or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include
5 discoloration, black spots, and clouding of the silver film.
- 6 1. Warranty Period: **Five** years from date of **Substantial Completion**.

7 PART 2 - PRODUCTS

8 2.1 SILVERED FLAT GLASS MIRRORS

9 A. Mirrors, General: ASTM C 1503.

10 B. Laminated Mirrors: ASTM C 1172, Type II.

- 11 1. Glass for Outer Lite: Annealed float glass, Mirror **Glazing** Quality, **clear**.
12 2. Nominal Thickness for Outer Lite: **3.0 mm minimum based on size**.
13 3. Glass for Inner Lite: Heat-strengthened float glass; ASTM C 1048 Type I; Quality-Q3; Class I (clear) Kind HS,
14 Condition A.
15 4. Nominal Thickness: **3.0 mm minimum based on size**.
16 5. Interlayer: Mirror manufacturer's standard **0.030-inch- (0.76-mm-)** thick, clear polyvinyl-butylal interlayer
17 with a proven record of showing no tendency to delaminate from, or cause damage to, silver coating.

18 C. Safety Glazing Products: For **laminated** mirrors, provide products that comply with 16 CFR 1201, Category II.

19 D. Size (TA-4):

- 20 1. 24" x 36".

22 2.2 MISCELLANEOUS MATERIALS

23 A. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting
24 against silver deterioration at mirrored glass edges.

25 B. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified
26 by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be
27 installed.

28 2.3 MIRROR HARDWARE

29 A. Aluminum J-Channels and Cleat: Aluminum extrusions with a return deep enough to produce a glazing channel to
30 accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

31 1. Bottom Trim: J-channels formed with front leg and back leg not less than **5/16 and 3/4 inch (7.9 and 19 mm)**
32 in height, respectively.

33 2. Top Trim: Formed with front leg with a height matching bottom trim and back leg designed to fit into the
34 pocket created by wall-mounted aluminum cleat.

35 3. Finish: **Clear** bright anodized.

1 B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture
2 where fasteners are exposed.

3 C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield,
4 expansion-bolt devices for drilled-in-place anchors.

5 2.4 FABRICATION

6 A. Fabricate mirrors in the shop to greatest extent possible.

7 B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they
8 fit closely around penetrations in mirrors.

9 C. Mirror Edge Treatment: **Flat polished.**

10 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric
11 penetration of glass coating.

12 PART 3 - EXECUTION

13 3.1 EXAMINATION

14 A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation
15 tolerances, substrate preparation, and other conditions affecting performance of the Work.

16 B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with
17 mirror mastic.

18 C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

19 3.2 PREPARATION

20 A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating
21 substrates with mastic manufacturer's special bond coating where applicable.

22 3.3 INSTALLATION

23 A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA
24 publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

25 1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on
26 the Care and Handling of Mirrors."

27 B. Provide a minimum airspace of **1/8 inch (3 mm)** between back of mirrors and mounting surface for air circulation
28 between back of mirrors and face of mounting surface.

29 C. Install mirrors with **mastic and** mirror hardware. Attach mirror hardware securely to mounting surfaces with
30 mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point
31 loads on backs of mirrors.
32

- 1 1. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat
- 2 fastened directly to wall.
- 3 2. Install mastic as follows:
 - 4 a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and
 - 5 backing material.
 - 6 b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow
 - 7 air circulation between back of mirrors and face of mounting surface.
 - 8 c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of
 - 9 **1/8 inch (3 mm)** between back of mirrors and mounting surface.

10 3.4 CLEANING AND PROTECTION

- 11 A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- 12 B. Do not permit edges of mirrors to be exposed to standing water.
- 13 C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or
- 14 other sources for continuous periods of time.
- 15 D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date
- 16 of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

17 END OF SECTION 088300

1 SECTION 089119 - FIXED LOUVERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

8 1. Fixed extruded-aluminum louvers.

- 9 B. Related Requirements:

10 1.3 DEFINITIONS

11 A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless
12 otherwise defined in this Section or in referenced standards.

13 B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

14 C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and
15 mullions, which carry it to bottom of unit and away from opening.

16 D. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by
17 testing according to AMCA 500-L.

18 1.4 ACTION SUBMITTALS

- 19 A. Product Data: For each type of product.

20 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with
21 appropriate AMCA Certified Ratings Seals.

- 22 B. Sustainable Design Submittal.

23 1. Product Data for Credit EQ 4.1: For glazing sealants, including printed statement of VOC content and
24 chemical components.

25 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
26 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
27 product having recycled content.

28 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
29 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
30 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
31 material, and fraction by weight that is considered regional.
32

1 C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other
2 work. Show frame profiles and blade profiles, angles, and spacing.

- 3 1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
- 4 2. Show mullion profiles and locations.

5 D. Samples: For each type of metal finish required.

6 1.5 INFORMATIONAL SUBMITTALS

7 A. Sample Warranties: For manufacturer's special warranties.

8 1.6 FIELD CONDITIONS

9 A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

10 1.7 WARRANTY

11 A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or
12 workmanship within specified warranty period.

13 1. Deterioration includes, but is not limited to, the following:

- 14 a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
- 15 b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
- 16 c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

17 2. Warranty Period: 10 years from date of Substantial Completion.

18 PART 2 - PRODUCTS

19 2.1 MANUFACTURERS

20 A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of
21 same type, design, or factory-applied color finish.

22 2.2 PERFORMANCE REQUIREMENTS

23 A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses
24 within limits and under conditions indicated without permanent deformation of louver components, noise or metal
25 fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures
26 shall be considered to act normal to the face of the building.

27 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

28 B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing
29 manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

30 C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

- 1 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- 2 D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for
3 fabrication, construction details, and installation procedures.
- 4 2.3 FIXED EXTRUDED-ALUMINUM LOUVERS
- 5 A. Horizontal, Continuous-Line, Drainable-Blade Louver: Drainable-blade louver with blade gutters (drains) in rear two-
6 thirds of blades only.
- 7 1. Louver Depth: 6 inches (150 mm).
- 8 2. Frame and Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).
- 9 3. Mullion Type: Semirecessed.
- 10 4. Louver Performance Ratings:
- 11 a. Free Area: Not less than 7.8 sq. ft. (0.72 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-
12) high louver.
- 13 b. Point of Beginning Water Penetration: Not less than 850 fpm (4.3 m/s).
- 14 c. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 800-fpm (4.1-m/s)
15 free-area exhaust or intake velocity.
- 16 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- 17 2.4 LOUVER SCREENS
- 18 A. General: Provide screen at each exterior louver.
- 19 1. Screen Location for Fixed Louvers: Exterior face.
- 20 2. Screening Type: Bird screening.
- 21 B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a
22 maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.
- 23 C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
- 24 1. Metal: Same type and form of metal as indicated for louver to which screens are attached.
- 25 2. Finish: Same finish as louver frames to which louver screens are attached.
- 26 3. Type: Non-rewirable, U-shaped frames.
- 27 D. Louver Screening for Aluminum Louvers:
- 28 1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.
- 29 2.5 BLANK-OFF PANELS
- 30 A. Uninsulated Blank-Off Panels: Metal sheet attached to back of louver.
- 31 1. Aluminum sheet for aluminum louvers, not less than 0.050-inch (1.27-mm) nominal thickness.
- 32 2. Panel Finish: Same finish applied to louvers.
- 33 B. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal
34 sheets and attached to back of louver.

- 1 1. Thickness: **2 inches (50 mm)**.
- 2 2. Metal Facing Sheets: Aluminum sheet, not less than **0.032-inch (0.81-mm)** nominal thickness.
- 3 3. Insulating Core: extruded-polystyrene foam.
- 4 4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard channel frames, with corners mitered and with same finish as panels.
- 5 5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
- 6 6. Panel Finish: Same finish applied to louvers.

8 2.6 MATERIALS

- 9 A. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5, T-52, or T6.
- 10 B. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, Alloy 3003 or 5005, with temper as required for forming, or as
11 otherwise recommended by metal producer for required finish.
- 12 C. Fasteners: Use types and sizes to suit unit installation conditions.
 - 13 1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
 - 14 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 15 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- 16 D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-
17 steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and
18 ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E 488/E 488M
19 conducted by a qualified testing agency.
- 20 E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

21 2.7 FABRICATION

- 22 A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and
23 handling limitations. Clearly mark units for reassembly and coordinated installation.
- 24 B. Maintain equal louver blade spacing to produce uniform appearance.
- 25 C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication
26 and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 27 1. Frame Type: Channel unless otherwise indicated.
- 28 D. Include supports, anchorages, and accessories required for complete assembly.
- 29 E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or
30 **72 inches (1830 mm)** o.c., whichever is less.
 - 31 1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver
32 blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate
33 with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
- 34 F. Provide subsills made of same material as louvers or extended sills for recessed louvers.
- 35 G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless
36 otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

- 1 2.8 ALUMINUM FINISHES
- 2 A. Finish louvers after assembly.
- 3 B. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
- 4 1. Color: Light bronze.
- 5 2. Color: Match Architect's sample.
- 6 C. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with **AAMA 2605** and containing not
- 7 less than **70** percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal
- 8 surfaces to comply with coating and resin manufacturers' written instructions.
- 9 1. Color and Gloss: **Match Architect's sample.**

10 PART 3 - EXECUTION

11 3.1 EXAMINATION

- 12 A. Examine substrates and openings, with Installer present, for compliance with requirements for installation
- 13 tolerances and other conditions affecting performance of the Work.
- 14 B. Proceed with installation only after unsatisfactory conditions have been corrected.

15 3.2 PREPARATION

- 16 A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that
- 17 are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

18 3.3 INSTALLATION

- 19 A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- 20 B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect
- 21 metal surfaces and to make a weathertight connection.
- 22 C. Form closely fitted joints with exposed connections accurately located and secured.
- 23 D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- 24 E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or
- 25 dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by
- 26 separating surfaces with waterproof gaskets or nonmetallic flashing.
- 27 F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight
- 28 louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver
- 29 installation.

- 1 3.4 ADJUSTING AND CLEANING
- 2 A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during
3 construction period. Do not let soil accumulate during construction period.
- 4 B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes.
5 Thoroughly rinse surfaces and dry.
- 6 C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results
7 of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
- 8 END OF SECTION 089119

1 SECTION 092216 - NON-STRUCTURAL METAL FRAMING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Non-load-bearing steel framing systems for interior partitions.
9 2. Suspension systems for interior ceilings and soffits.
10 3. Grid suspension systems for gypsum board ceilings.

11 B. Related Requirements:

- 12 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-
13 bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

14 1.3 ACTION SUBMITTALS

- 15 A. Product Data: For each type of product.

16 B. Sustainable Design Submittals:

- 17 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages
18 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
19 product having recycled content.
- 20 2. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply
21 with requirements for regional materials, certificates indicating location of material manufacturer and point
22 of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project,
23 cost for each regional material, and fraction by weight that is considered regional.

24 1.4 INFORMATIONAL SUBMITTALS

- 25 A. Product Certificates: For each type of code-compliance certification for studs and tracks.

- 26 B. Evaluation Reports: For **firestop tracks** from ICC-ES or other qualified testing agency acceptable to authorities
27 having jurisdiction.

1 PART 2 - PRODUCTS

2 2.1 PERFORMANCE REQUIREMENTS

3 A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel
4 framing, provide materials and construction identical to those tested in assembly indicated, according to
5 ASTM E 119 by an independent testing agency.

6 B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in
7 assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent
8 testing agency.

9 2.2 FRAMING SYSTEMS

10 A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content
11 not less than 30 percent.

12 B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

13 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

14 2. Protective Coating: **ASTM A 653/A 653M, G40 (Z120)**, hot-dip galvanized unless otherwise indicated.

15 C. Studs and Tracks: ASTM C 645.

16 1. Steel Studs and Tracks:

17 a. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm) for studs where installed height is 12'-0"
18 or less or as indicated on the drawings, or 0.0296 inch (0.752 mm) for studs where installed height is
19 greater than 12'-0" or as indicated on the drawings.

20 b. Depth: 3-5/8 inches (92 mm) for studs where installed height is 16'-0" or less or as indicated on the
21 drawings, or 6 inches (152 mm) for studs where installed height is greater than 16'-0" or as
22 indicated on the drawings.

23 D. Slip-Type Head Joints: Where indicated, provide **one of** the following:

24 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment
25 of studs to tracks while allowing **2-inch (51-mm)** minimum vertical movement.

26 2. Single Long-Leg Track System: ASTM C 645 top track with **2-inch- (51-mm-)** deep flanges in thickness not less
27 than indicated for studs, installed with studs friction fit into top track and with continuous bridging located
28 within **12 inches (305 mm)** of the top of studs to provide lateral bracing.

29 3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior
30 partition framing resulting from deflection of structure above; in thickness not less than indicated for studs
31 and in width to accommodate depth of studs.

32 E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of
33 structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than
34 indicated for studs and in width to accommodate depth of studs.

35 F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

36 1. Minimum Base-Metal Thickness: **0.0296 inch (0.752 mm)**.

38 G. Cold-Rolled Channel Bridging: Steel, **0.0538-inch (1.367-mm)** minimum base-metal thickness, with minimum **1/2-**
39 **inch- (13-mm-)** wide flanges.

40 1. Depth: **1-1/2 inches (38 mm)**.

- 1 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized
2 steel.
- 3 H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
4
- 5 1. Minimum Base-Metal Thickness: 0.0179 inch (0.455 mm).
6 2. Depth: 7/8 inch (22.2 mm) or 1-1/2 inches (38 mm) as indicated on drawings.
- 7 I. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.
8
- 9 1. Configuration: **Asymmetrical**.
10
- 11 J. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-)
12 wide flanges.
13
- 14 1. Depth: 3/4 inch (19 mm).
15 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of
16 0.0329 inch (0.8 mm).
17 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or
18 double strand of 0.048-inch- (1.21-mm-) diameter wire.
- 19 K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of
20 7/8 inch (22 mm), minimum uncoated-metal thickness of 0.0179 inch (0.455 mm), and depth required to fit
21 insulation thickness indicated.
- 19 2.3 SUSPENSION SYSTEMS
- 20 A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double
21 strand of 0.048-inch- (1.21-mm-) diameter wire.
- 22 B. Hanger Attachments to Concrete:
- 23 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having
24 jurisdiction as appropriate for the substrate.
- 25 a. Uses: Securing hangers to structure.
26 b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or
27 ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
28 c. Material for Exterior: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts,
29 ASTM F 594 (ASTM F 836M).
- 30 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having
31 jurisdiction, based on ICC-ES AC70.
- 32 C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- 33 D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch
34 (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
- 35 1. Depth: 2-1/2 inches, or 2 inches, or 1-1/2 inches as indicated on drawings.
- 36 E. Furring Channels (Furring Members):
- 37 1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-)
38 wide flanges, 3/4 inch (19 mm) deep.
39 2. Steel Studs and Tracks: ASTM C 645.

- 1 a. Minimum Base-Metal Thickness: **0.0179 inch (0.455 mm)** or as **indicated on Drawings**.
2 b. Depth: **As indicated on Drawings**.
- 3 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, **7/8 inch (22 mm)** deep.
- 4 a. Minimum Base-Metal Thickness: **0.0179 inch (0.455 mm)**.
- 5 4. Resilient Furring Channels: **1/2-inch- (13-mm-)** deep members designed to reduce sound transmission.
- 6 a. Configuration: **Asymmetrical**.
- 7 F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and
8 cross-furring members that interlock.

9 2.4 AUXILIARY MATERIALS

10 A. General: Provide auxiliary materials that comply with referenced installation standards.

11 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other
12 properties required to fasten steel members to substrates.

13 B. Isolation Strip at Exterior Walls: Provide **one of** the following:

- 14 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
15 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam
16 displacement, **1/8 inch (3.2 mm)** thick, in width to suit steel stud size.

17 PART 3 - EXECUTION

18 3.1 EXAMINATION

19 A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors,
20 and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

21 B. Proceed with installation only after unsatisfactory conditions have been corrected.

22 3.2 PREPARATION

23 A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to
24 ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers
25 at spacing required to support the Work and that hangers will develop their full strength.

26 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time
27 needed for coordination and construction.

28 3.3 INSTALLATION, GENERAL

29 A. Installation Standard: ASTM C 754.

30 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- 1 B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- 2 C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet
3 accessories, furnishings, or similar construction.
- 4 D. Install bracing at terminations in assemblies.
- 5 E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides
6 of joints independently.
- 7 3.4 INSTALLING FRAMED ASSEMBLIES
- 8 A. Install framing system components according to spacings indicated, but not greater than spacings required by
9 referenced installation standards for assembly types.
- 10 1. Single-Layer Application: **16 inches (406 mm) o.c.** unless otherwise indicated.
- 11 2. Multilayer Application: **16 inches (406 mm) o.c.** unless otherwise indicated.
- 12 3. Tile Backing Panels: **16 inches (406 mm) o.c.** unless otherwise indicated.
- 13 B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install
14 isolation strip between studs and exterior wall.
- 15 C. Install studs so flanges within framing system point in same direction.
- 16 D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above
17 suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing
18 around ducts that penetrate partitions above ceiling.
- 19 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at
20 tops of framing systems that prevent axial loading of finished assemblies.
- 21 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for
22 cripple studs) at head and secure to jamb studs.
- 23 a. Install two studs at each jamb unless otherwise indicated.
- 24 b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
- 25 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings
26 unless otherwise indicated. Install framing below sills of openings to match framing required above door
27 heads.
- 28 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and
29 support closures and to make partitions continuous from floor to underside of solid structure.
- 30 a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly
31 indicated.
- 32 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- 33 6. Curved Partitions:
- 34 a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
- 35 b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight
36 lengths of no fewer than two studs at ends of arcs, place studs **6 inches (150 mm) o.c.**
- 37 E. Direct Furring:
- 38 1. Screw to wood framing.

- 1 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven
2 fasteners spaced **24 inches (610 mm)** o.c.
- 3 F. Z-Shaped Furring Members:
- 4 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped
5 furring members spaced **24 inches (610 mm)** o.c.
- 6 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub
7 nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
- 8 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond
9 corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel.
10 At interior corners, space second member no more than **12 inches (305 mm)** from corner and cut insulation
11 to fit.
- 12 G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from
13 the plane formed by faces of adjacent framing.
- 14 3.5 INSTALLING CEILING SUSPENSION SYSTEMS
- 15 A. Install suspension system components according to spacings indicated, but not greater than spacings required by
16 referenced installation standards for assembly types.
- 17 1. Hangers: **48 inches (1219 mm)** o.c.
- 18 2. Carrying Channels (Main Runners): **48 inches (1219 mm)** o.c.
- 19 3. Furring Channels (Furring Members): **16 inches (406 mm)** o.c.
- 20 B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to
21 prevent transfer of loading imposed by structural movement.
- 22 C. Suspend hangers from building structure as follows:
- 23 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are
24 not part of supporting structural or suspension system.
- 25 a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by
26 bracing, countersplaying, or other equally effective means.
- 27 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere
28 with locations of hangers required to support standard suspension system members, install supplemental
29 suspension members and hangers in the form of trapezes or equivalent devices.
- 30 a. Size supplemental suspension members and hangers to support ceiling loads within **performance**
31 **limits established by referenced installation standards.**
- 32 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or
33 other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not
34 cause hangers to deteriorate or otherwise fail.
- 35 4. Do not attach hangers to steel roof deck.
- 36 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through
37 forms.
- 38 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
- 39 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- 40 D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

- 1 E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical
2 surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- 3 F. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet (3 mm in 3.6 m)**
4 measured lengthwise on each member that will receive finishes and transversely between parallel members that
5 will receive finishes.
- 6 END OF SECTION 092216

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1 SECTION 092900 - GYPSUM BOARD

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Interior gypsum board.
9 2. Tile backing panels.
10 3. Texture finishes.

11 B. Related Requirements:

- 12 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
13 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners,
14 and other components of shaft-wall assemblies.
15 3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems
16 that support gypsum board panels.

17 1.3 ACTION SUBMITTALS

18 A. Product Data: For each type of product.

19 B. Sustainable Design Submittals.

- 20
21 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
22 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
23 product having recycled content.
24 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
25 regionally manufactured and regionally extracted and manufactured materials. Include statement
26 indicating cost for each regionally manufactured material.
27 a. Include statement indicating location of manufacturer and distance to Project for each regionally
28 manufactured material.
29 b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery
30 for each raw material used in regionally extracted and manufactured materials. Indicate distance to
31 Project and fraction by weight of each regionally manufactured material that is regionally extracted.
32 3. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates,
33 documentation including printed statement of VOC content.

34 C. Samples for Verification: For the following products:

- 35 1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

- 1 1.4 QUALITY ASSURANCE
- 2 A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set
3 quality standards for materials and execution.
- 4 1. Build mockups for the following:
- 5 a. Each level of gypsum board finish indicated for use in exposed locations.
6 b. Each texture finish indicated.
- 7 2. Apply or install final decoration indicated, including painting on exposed surfaces for review of mockups.
8 3. Simulate finished lighting conditions for review of mockups.
9 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if
10 undisturbed at time of Substantial Completion.

11 1.5 DELIVERY, STORAGE AND HANDLING

- 12 A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight,
13 construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat
14 platform to prevent sagging.

15 1.6 FIELD CONDITIONS

- 16 A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written
17 instructions, whichever are more stringent.
- 18 B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- 19 C. Do not install panels that are wet, moisture damaged, and mold damaged.
- 20 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging,
21 or irregular shape.
22 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface
23 contamination and discoloration.

24 PART 2 - PRODUCTS

25 2.1 PERFORMANCE REQUIREMENTS

- 26 A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical
27 to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- 28 B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in
29 assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing
30 agency.

31 2.2 GYPSUM BOARD, GENERAL

- 32 A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer
33 recycled content not less than 95 percent.

- 1 B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.
- 2 C. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with
3 support system indicated.
- 4 2.3 INTERIOR GYPSUM BOARD
- 5 A. Gypsum Wallboard: ASTM C 1396/C 1396M.
- 6 1. Thickness: 5/8 inch.
7 2. Long Edges: Tapered.
- 8 B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
- 9 1. Thickness: 5/8 inch (15.9 mm).
10 2. Long Edges: Tapered.
- 11 C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than
12 standard regular-type gypsum board of same thickness.
- 13 1. Thickness: 1/4 inch (6.4 mm).
14 2. Long Edges: Tapered.
- 15 D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
- 16 1. Thickness: 1/2 inch (12.7 mm).
17 2. Long Edges: Tapered.
- 18 E. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
- 19 1. Core: 5/8 inch regular type or 5/8 inch Type X as required.
20 2. Long Edges: Tapered.
21 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 22 2.4 SPECIALTY GYPSUM BOARD
- 23 A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
24
25 1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
26 2. Long Edges: Tapered.
- 27 2.5 TILE BACKING PANELS
- 28 A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
- 29 1. Thickness: 5/8 inch.
30 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- 31 2.6 TRIM ACCESSORIES
- 32 A. Interior Trim: ASTM C 1047.

- 1 1. Material: **Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel**
2 **sheet.**
3 2. Shapes:
- 4 a. Cornerbead.
 - 5 b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - 6 c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - 7 d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - 8 e. Expansion (control) joint.
 - 9 f. Curved-Edge Cornerbead: With notched or flexible flanges.

10 B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

- 11 1. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B 221**
12 **(ASTM B 221M)**, Alloy 6063-T5.
13 2. Finish: **Corrosion-resistant primer compatible with joint compound and finish materials specified.**
14

15 2.7 JOINT TREATMENT MATERIALS

16 A. General: Comply with ASTM C 475/C 475M.

17 B. Joint Tape:

- 18 1. Interior Gypsum Board: Paper.
19 2. Tile Backing Panels: As recommended by panel manufacturer.

20 C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other
21 compounds applied on previous or for successive coats.

- 22 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
23 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use
24 **setting-type taping** compound.

25 a. Use setting-type compound for installing paper-faced metal trim accessories.

- 26 3. Fill Coat: For second coat, use **setting-type, sandable topping** compound.
27 4. Finish Coat: For third coat, use **setting-type, sandable topping or drying-type, all-purpose** compound.

28 D. Joint Compound for Tile Backing Panels:

- 29 1. Cementitious Backer Units: As recommended by backing panel manufacturer.

30 2.8 AUXILIARY MATERIALS

31 A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written
32 instructions.

33 B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to
34 continuous substrate.

- 35 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59,
36 Subpart D (EPA Method 24).
37

38 C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

- 1 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch
2 (0.84 to 2.84 mm) thick.
- 3 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

- 4 D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining
5 thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

- 6 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- 7 2. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled
8 content not less than 30 percent.

- 9 E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

- 10 F. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

11 PART 3 - EXECUTION

12 3.1 EXAMINATION

- 13 A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present,
14 for compliance with requirements and other conditions affecting performance of the Work.

- 15 B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

- 16 C. Proceed with installation only after unsatisfactory conditions have been corrected.

17 3.2 APPLYING AND FINISHING PANELS, GENERAL

- 18 A. Comply with ASTM C 840.

- 19 B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints
20 in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

- 21 C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16
22 inch (1.5 mm) of open space between panels. Do not force into place.

- 23 D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum
24 board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger
25 vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed
26 openings.

- 27 E. Form control and expansion joints with space between edges of adjoining gypsum panels.

- 28 F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases
29 braced internally.

- 30 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be
31 accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
- 32 2. Fit gypsum panels around ducts, pipes, and conduits.
- 33 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut
34 gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide
35 joints to install sealant.

- 1 G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide **1/4- to**
2 **1/2-inch- (6.4- to 12.7-mm-)** wide spaces at these locations and trim edges with edge trim where edges of panels
3 are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- 4 H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported)
5 edges of stud flanges first.
- 6 I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations
7 with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and
8 through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim
9 and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical
10 ceilings.
- 11 J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels
12 have been installed on one side.

13 3.3 APPLYING INTERIOR GYPSUM BOARD

- 14 A. Install interior gypsum board in the following locations:
- 15 1. Wallboard Type: **Vertical surfaces unless otherwise indicated.**
16 2. Type X: **Where required for fire-resistance-rated assembly.**
17 3. Flexible Type: **Apply in double layer at curved assemblies.**
18 4. Ceiling Type: **Ceiling surfaces.**
19 5. Mold-Resistant Type: **As indicated on Drawings.**
20 6. Type C: **Where required for specific fire-resistance-rated assembly indicated.**
- 21 B. Single-Layer Application:
- 22 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at
23 right angles to framing unless otherwise indicated.
- 24 2. On partitions/walls, apply gypsum panels **vertically (parallel to framing)** unless otherwise indicated or
25 required by fire-resistance-rated assembly, and minimize end joints.
- 26 a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
27 b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required
28 by fire-resistance-rated assembly.
- 29 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints.
30 Locate edge joints over furring members.
- 31 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- 32 C. Multilayer Application:
- 33 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions;
34 apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-
35 layer joints one framing member, **16 inches (400 mm)** minimum, from parallel base-layer joints, unless
36 otherwise indicated or required by fire-resistance-rated assembly.
- 37 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to
38 framing) with joints of base layers located over stud or furring member and face-layer joints offset at least
39 one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-
40 rated assembly. Stagger joints on opposite sides of partitions.
- 41 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically
42 (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring
43 member. Locate edge joints of base layer over furring members.
- 44 4. Fastening Methods: Fasten base layers **and face layers separately to supports with screws.**

1 D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs,
2 joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written
3 instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

4 E. Curved Surfaces:

- 5 1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved
6 surface plus **12-inch- (300-mm-)** long straight sections at ends of curves and tangent to them.
- 7 2. For double-layer construction, fasten base layer to studs with screws **16 inches (400 mm)** o.c. Center
8 gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches (300**
9 **mm)** o.c.

10 3.4 APPLYING TILE BACKING PANELS

11 A. Cementitious Backer Units: ANSI A108.11, at **locations indicated to receive tile and solid surface wall panels.**

12 B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane
13 across panel surfaces.

14 3.5 INSTALLING TRIM ACCESSORIES

15 A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels.
16 Otherwise, attach trim according to manufacturer's written instructions.

17 B. Control Joints: Install control joints **according to ASTM C 840 and in specific locations approved by Architect for**
18 **visual effect.**

19 C. Interior Trim: Install in the following locations:

- 20 1. Cornerbead: Use at outside corners.
- 21 2. LC-Bead: Use **at exposed panel edges.**
- 22 3. L-Bead: Use **where indicated.**
- 23 4. U-Bead: Use **where indicated.**
- 24 5. Curved-Edge Cornerbead: Use at curved openings.

25 D. Aluminum Trim: Install in locations **indicated on Drawings.**

26 3.6 FINISHING GYPSUM BOARD

27 A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface
28 defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual
29 joint compound from adjacent surfaces.

30 B. Prefill open joints and damaged surface areas.

31 C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive
32 tape.

33 D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

- 34 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
- 35 2. Level 2: **Panels that are substrate for tile.**
- 36 3. Level 4: **At panel surfaces that will be exposed to view unless otherwise indicated.**

1 a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

2 E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3 3.7 PROTECTION

4 A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall
5 surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

6 B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other
7 causes during remainder of the construction period.

8 C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

9 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging,
10 or irregular shape.

11 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface
12 contamination and discoloration.

13 END OF SECTION 092900

1 SECTION 093013 - CERAMIC TILING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Porcelain tile.
9 2. Waterproof membrane for thinset applications.
10 3. Crack isolation membrane.
11 4. Metal edge strips.

12 B. Related Requirements:

- 13 1. Section 071413 Hot Fluid-Applied Rubberized Asphalt Waterproofing for waterproofing under thickset
14 mortar beds.
15 2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile
16 surfaces.
17 3. Section 092900 "Gypsum Board" for cementitious backer units, glass-mat, water-resistant backer board.

18 1.3 DEFINITIONS

- 19 A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this
20 Section unless otherwise specified.

- 21 B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4,
22 ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13,
23 ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for
24 Installation of Ceramic Tile."

- 25 C. Module Size: Actual tile size plus joint width indicated.

- 26 D. Face Size: Actual tile size, excluding spacer lugs.

27 1.4 SUBMITTALS

- 28 A. Product Data: For each type of product.

- 29 B. Sustainable Design Submittals:

30 LEED Submittal:

- 31 1. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.
32 2. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation
33 indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement
34 indicating cost for each product having recycled content.

- 1 3. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply
2 with requirements for regional materials, certificates indicating location of material manufacturer and point
3 of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project,
4 cost for each regional material, and fraction by weight that is considered regional.
- 5 C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of
6 expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- 7 D. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- 8 E. Samples for Verification:
- 9 1. Full-size units of each type and composition of tile and for each color and finish required
10 2. Full-size units of each type of trim and accessory for each color and finish required.
11 3. Metal edge strips in 6-inch (150-mm) lengths.
- 12 1.5 INFORMATIONAL SUBMITTALS
- 13 A. Qualification Data: For Installer.
- 14 B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and
15 Installer.
- 16 C. Product Certificates: For each type of product.
- 17 D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.
- 18 1.6 MAINTENANCE MATERIAL SUBMITTALS
- 19 A. Furnish extra materials that match and are from same production runs as products installed and that are packaged
20 with protective covering for storage and identified with labels describing contents.
- 21 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type,
22 composition, color, pattern, and size indicated.
- 23 1.7 QUALITY ASSURANCE
- 24 A. Installer Qualifications:
25 1. Company specializing in performing tile installation, with minimum of 5 years of documented experience.
- 26 1.8 DELIVERY, STORAGE, AND HANDLING
- 27 A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use.
28 Comply with requirements in ANSI A137.1 for labeling tile packages.
- 29 B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- 30 C. Store aggregates where grading and other required characteristics can be maintained and contamination can be
31 avoided.
- 32 D. Store liquid materials in unopened containers and protected from freezing.

1 1.9 FIELD CONDITIONS

2 A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and
3 humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written
4 instructions.

5 PART 2 - PRODUCTS

6 2.1 MANUFACTURERS

7 A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

8 1. Obtain tile of each type and color or finish from same production run and of consistent quality in
9 appearance and physical properties for each contiguous area.

10 B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar,
11 adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

12 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single
13 manufacturer.

14 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer
15 of setting and grouting materials.

16 C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single
17 manufacturer:

18 1. Waterproof membrane.

19 2. Crack isolation membrane.

20 3. Cementitious backer units.

21 4. Metal edge strips.

22 2.2 PRODUCTS, GENERAL

23 A. Recycled Content of ceramic tile Products: Postconsumer recycled content plus one-half of preconsumer recycled
24 content not less than 60 percent

25 B. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other
26 characteristics indicated.

27 1. Provide tile complying with Standard grade requirements unless otherwise indicated.

28 C. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards
29 referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile
30 installation schedules, and other requirements specified.

31 D. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units
32 taken from one package show same range in colors as those taken from other packages and match approved
33 Samples.

34 E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer
35 unless otherwise indicated.

36 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless
37 tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has
38 a record of successful in-service performance.

- 1 2.3 TILE PRODUCTS
- 2 A. Ceramic Tile Type CT-1: Porcelain Tile
- 3 1. Distributor: Ceramic Tileworks
- 4 2. Style: Modern
- 5 3. Color: Black
- 6 4. Size: 12x24
- 7 5. Installation: Monolithic
- 8 6. Dynamic Coefficient of Friction: Not less than 0.42.
- 9 7. Grout Color: As selected by Architect from manufacturer's full range
- 10 B. Ceramic Tile Type CT-2: Porcelain Tile
- 11 1. Distributor: Ceramic Tileworks
- 12 2. Style: Contemporary Stone
- 13 3. Color: Grey
- 14 4. Size: 6x36
- 15 5. Installation: Horizontal ½ offset
- 16 6. Grout Color: As selected by Architect from manufacturer's full range
- 17 C. Ceramic Tile Type CT-3: Porcelain Tile
- 18 1. Distributor: Childcrest Tile & Stone
- 19 2. Style: Twin Pine
- 20 3. Color: Farmwood
- 21 4. Size: 6x36
- 22 5. Installation: 1/2 Offset
- 23 6. Dynamic Coefficient of Friction: Not less than 0.42.
- 24 7. Grout Color: As selected by Architect from manufacturer's full range
- 25 D. Ceramic Tile Type CTB-1: Porcelain Tile Base
- 26 1. Distributor: Ceramic Tileworks
- 27 2. Style: Modern
- 28 3. Color: Black
- 29 4. Size: Cut 12x24 to 6 x 24 size
- 30 5. Provide metal trim at exposed top edge of wall base
- 31 6. Grout Color: As selected by Architect from manufacturer's full range
- 32 2.4 WATERPROOF MEMBRANE.
- 33 A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the
- 34 manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- 35 2.5 CRACK ISOLATION MEMBRANE
- 36 A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is
- 37 recommended by the manufacturer for the application indicated. Include reinforcement and accessories
- 38 recommended by manufacturer.
- 39 2.6 GROUT MATERIALS
- 40 A. Standard Cement Grout: ANSI A118.6.
- 41 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
- 42 may be incorporated into the Work include, but are not limited to the following:

- 1 a. [ARDEX Americas.](#)
- 2 b. [Boiardi Products Corporation; a QEP company.](#)
- 3 c. [Bonsal American, an Oldcastle company.](#)
- 4 d. [Bostik, Inc.](#)
- 5 e. [C-Cure.](#)
- 6 f. [Custom Building Products.](#)
- 7 g. [H.B. Fuller Construction Products Inc. / TEC.](#)
- 8 h. [Jamo Inc.](#)
- 9 i. [LATICRETE SUPERCAP, LLC.](#)
- 10 j. [MAPEI Corporation.](#)
- 11 k. [Southern Grouts & Mortars, Inc.](#)
- 12 l. [Summitville Tiles, Inc.](#)

13 B. High-Performance Tile Grout: ANSI A118.7.

14 1. [Manufacturers:](#) Subject to compliance with requirements, available manufacturers offering products that
15 may be incorporated into the Work include, but are not limited to the following:

- 16 a. [ARDEX Americas.](#)
- 17 b. [Boiardi Products Corporation; a QEP company.](#)
- 18 c. [Bonsal American, an Oldcastle company.](#)
- 19 d. [Bostik, Inc.](#)
- 20 e. [C-Cure.](#)
- 21 f. [Custom Building Products.](#)
- 22 g. [H.B. Fuller Construction Products Inc. / TEC.](#)
- 23 h. [Jamo Inc.](#)
- 24 i. [LATICRETE SUPERCAP, LLC.](#)
- 25 j. [MAPEI Corporation.](#)
- 26 k. [Southern Grouts & Mortars, Inc.](#)
- 27 l. [Summitville Tiles, Inc.](#)

- 28 2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other
29 dry ingredients.
- 30 3. Polymer Type: [Acrylic resin] [or] [styrene-butadiene rubber] in liquid-latex form for addition to
31 prepackaged dry-grout mix.

32 2.7 MISCELLANEOUS MATERIALS

- 33 A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided
34 or approved by manufacturer of tile-setting materials for installations indicated.
- 35 B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils (0.1 mm) thick.
- 36 C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic, designed specifically
37 for flooring applications; stainless-steel, exposed-edge material.
- 38 D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces,
39 specifically approved for materials and installations indicated by tile and grout manufacturers.
- 40 E. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance
41 of grout.

- 1 2.8 MIXING MORTARS AND GROUT
- 2 A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written
3 instructions.
- 4 B. Add materials, water, and additives in accurate proportions.
- 5 C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to
6 produce mortars and grouts of uniform quality with optimum performance characteristics for installations
7 indicated.

8 PART 3 - EXECUTION

9 3.1 EXAMINATION

- 10 A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with
11 requirements for installation tolerances and other conditions affecting performance of the Work.
- 12 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-
13 setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone;
14 and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
- 15 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thinset mortar comply
16 with surface finish requirements in ANSI A108.01 for installations indicated.
- 17 a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
18 b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
- 19 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and
20 similar items located in or behind tile has been completed.
- 21 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated,
22 adjust joint locations in consultation with Architect.
- 23 B. Proceed with installation only after unsatisfactory conditions have been corrected.

24 3.2 PREPARATION

- 25 A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable
26 leveling and patching compound specifically recommended by tile-setting material manufacturer.
- 27 B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies
28 with ANSI A108.1A and is sloped **1/4 inch per foot (1:50)** toward drains.
- 29 C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units
30 taken from one package show same range of colors as those taken from other packages and match approved
31 Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

32 3.3 CERAMIC TILE INSTALLATION

- 33 A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods
34 specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of
35 Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to
36 types of setting and grouting materials used.

- 1 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for
2 providing 95 percent mortar coverage:
3 a. Tile floors in wet areas.
4 b. Tile floors consisting of tiles 8 by 8 inches (200 by 200 mm) or larger.
5 c. Tile floors consisting of rib-backed tiles.
- 6 B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without
7 interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without
8 disrupting pattern or joint alignments.
- 9 C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces.
10 Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to
11 electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- 12 D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- 13 E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both
14 directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half
15 of a tile. Provide uniform joint widths unless otherwise indicated.
16 1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
17 2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or
18 trim, align joints unless otherwise indicated.
- 19 F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
20 1. Porcelain Tile: 1/8 inch (1.6 mm)
- 21 G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and
22 isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not
23 saw-cut joints after installing tiles.
- 24 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- 25 H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes
26 flush with or below top of tile and no threshold is indicated.
- 27 3.4 WATERPROOFING INSTALLATION
- 28 A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof
29 membrane of uniform thickness that is bonded securely to substrate.
- 30 B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over
31 it.
- 32 3.5 CRACK ISOLATION MEMBRANE INSTALLATION
- 33 A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce
34 membrane of uniform thickness that is bonded securely to substrate.
- 35 B. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- 36 3.6 ADJUSTING AND CLEANING
- 37 A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units,
38 installed as specified and in a manner to eliminate evidence of replacement.

- 1 B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign
2 matter.
- 3 1. Remove grout residue from tile as soon as possible.
4 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no
5 sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and
6 only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be
7 cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean
8 water before and after cleaning.

9 3.7 PROTECTION

- 10 A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining,
11 damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile
12 walls and floors.
- 13 B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- 14 C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

15 3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- 16 A. Interior Floor Installations, Concrete Subfloor:
17 Tile Installation F111: Cement mortar bed (thickset) with cleavage membrane; TCA F111 and ANSI A108.1B.
18 Thin-Set Mortar for Cured-Bed Method: Latex-portland cement mortar.
19 Grout: Polymer-modified sanded grout.
20 Tile Installation F113: Thin-set mortar; TCA F113.
21 Thin-Set Mortar: Latex-portland cement mortar.
22 Grout: Polymer-modified sanded grout.
23 Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122.
24 Thin-Set Mortar: Latex-portland cement mortar.
25 Grout: Polymer-modified sanded grout.
26 Tile Installation F125A: Thin-set mortar on crack isolation membrane; TCA F125A.
27 Thin-Set Mortar: Latex-portland cement mortar.
28 Grout: Polymer-modified sanded grout.
29
- 30 B. Interior Wall Installations, Metal Studs or Furring:
31 Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
32 Thin-Set Mortar: Latex-portland cement mortar.
33 Grout: Polymer-modified sanded grout.
- 34 C. Shower Wall Installations, Wood or Metal Studs or Furring:
- 35 1. Ceramic Tile Installation: TCNA B412; thinset mortar on cementitious backer units or fiber-cement backer
36 board.
- 37 a. Ceramic Tile Type:
38 b. Thinset Mortar: Standard dry-set mortar.
39 c. Grout: High-performance unsanded grout.

40 END OF SECTION 093013

1 SECTION 095113 - ACOUSTICAL PANEL CEILINGS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

8 1.3 ACTION SUBMITTALS

- 9 A. Product Data: For each type of product.

10 B. LEED Submittals:

11 Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating
12 percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for
13 each product having recycled content.

14
15 Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with
16 requirements for regional materials, certificates indicating location of material manufacturer and point of
17 extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for
18 each regional material, and fraction by weight that is considered regional.

- 19 C. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.

- 20 D. Samples for Initial Selection: For components with factory-applied finishes.

- 21 E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples
22 of sizes indicated below:

- 23 1. Acoustical Panels: Set of **6-inch- (150-mm-)** Samples of each type, color, pattern, and texture.
24 2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch- (150-mm-)** long Samples of each
25 type, finish, and color.

26 1.4 CLOSEOUT SUBMITTALS

- 27 A. Maintenance Data: For finishes to include in maintenance manuals.

28 1.5 MAINTENANCE MATERIAL SUBMITTALS

- 29 A. Furnish extra materials from the same product run that match products installed and that are packaged with
30 protective covering for storage and identified with labels describing contents.

- 31 1. Acoustical Ceiling Units: Full-size panels equal to **2** percent of quantity installed.
32 2. Suspension-System Components: Quantity of each exposed component equal to **2** of quantity installed.

- 1 1.6 DELIVERY, STORAGE, AND HANDLING
- 2 A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully
3 enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature
4 extremes, direct sunlight, surface contamination, and other causes.
- 5 B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- 6 1.7 FIELD CONDITIONS
- 7 A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-
8 work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity
9 conditions are maintained at the levels indicated for Project when occupied for its intended use.
- 10 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical
11 panel ceiling installation.
- 12 PART 2 - PRODUCTS
- 13 2.1 MANUFACTURERS
- 14 A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single
15 source from single manufacturer.
- 16 2.2 PERFORMANCE REQUIREMENTS
- 17
- 18 A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products
19 with appropriate markings of applicable testing agency.
- 20 1. Flame-Spread Index: Class **A** according to ASTM E 1264.
- 21 2.3 ACOUSTICAL PANELS
- 22 A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus
23 one-half of preconsumer recycled content constitutes a minimum of 40 percent by weight.
- 24 B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be
25 incorporated into the Work include, but are not limited to the following:
- 26 1. [American Gypsum](#).
- 27 2. [Armstrong World Industries, Inc.](#)
- 28 3. [CertainTeed Corporation](#).
- 29 4. [Chicago Metallic Corporation](#).
- 30 5. [Rockfon \(Roxul Inc.\)](#).
- 31 6. [Tectum Inc.](#)
- 32 7. [USG Corporation](#).
- 33 C. Acoustical panels for acoustical panel ceiling ACT-1:
34 1. Manufacturer: Armstrong

- 1 2. Style: Optima Tegular 3251PB
- 2 3. Size: 24"x24"x1"
- 3 4. Grid: 9/16" Suprafine

- 4 D. Acoustical panels for acoustical panel ceiling ACT-2:
- 5 1. Manufacturer: Armstrong
- 6 2. Style: Ultima Healthzone 1936
- 7 3. Size: 24"x24"x3/4"
- 8 4. Grid: 9/16" Suprafine

9 2.4 METAL SUSPENSION SYSTEM

10 A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 90 percent.

12 B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 14 1. [Armstrong World Industries, Inc.](#)
- 15 2. [CertainTeed Corporation.](#)
- 16 3. [Chicago Metallic Corporation.](#)
- 17 4. [USG Corporation.](#)

18 C. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.

20 1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" according to ASTM C 635/C 635M.

22 2.5 ACCESSORIES

23 A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

25 1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to **10** times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

30 B. Wire Hangers, Braces, and Ties: Provide wires as follows:

- 31 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
- 32 2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
- 33 3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.
- 34 4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than **0.106-inch- (2.69-mm-)** diameter wire.

37 C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

38 D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

1 E. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick,
2 galvanized-steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted
3 connections and 5/16-inch- (8-mm-) diameter bolts.

4 2.6 ACOUSTICAL SEALANT

5 A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

6 PART 3 - EXECUTION

7 3.1 EXAMINATION

8 A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or
9 abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling
10 installation and anchorage and with requirements for installation tolerances and other conditions affecting
11 performance of acoustical panel ceilings.

12 B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold
13 damaged.

14 C. Proceed with installation only after unsatisfactory conditions have been corrected.

15 3.2 PREPARATION

16 A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of
17 each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout
18 shown on reflected ceiling plans.

19 B. Layout openings for penetrations centered on the penetrating items.

20 3.3 INSTALLATION

21 A. Install acoustical panel ceilings according to ASTM C 636/C 636M, and manufacturer's written instructions.

22 B. Suspend ceiling hangers from building's structural members and as follows:

23 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are
24 not part of supporting structure or of ceiling suspension system.

25 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere
26 with location of hangers at spacings required to support standard suspension-system members, install
27 supplemental suspension members and hangers in form of trapezes or equivalent devices.

28 3. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight
29 turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and
30 appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated
31 temperatures.

32 4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by
33 attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to
34 which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause
35 them to deteriorate or fail due to age, corrosion, or elevated temperatures.

36 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place
37 hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend
38 through forms into concrete.

- 1 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying
2 channels or other supplemental support for attachment of hanger wires.
3 7. Do not attach hangers to steel deck tabs.
4 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
5 9. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from
6 hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each
7 member.
8 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits
9 established by referenced standards.

10 C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and
11 replace dented, bent, or kinked members.

12 D. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge
13 moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

- 14 1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system
15 runners and moldings.
16 2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact
17 with top surface of runner flanges.
18 3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal
19 surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
20 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using
21 coating recommended in writing for this purpose by acoustical panel manufacturer.

22 3.4 ERECTION TOLERANCES

23 A. Suspended Ceilings: Install main and cross runners level to a tolerance of **1/8 inch in 12 feet (3 mm in 3.6 m)** non-
24 cumulative.

25 B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of
26 **1/8 inch in 12 feet (3 mm in 3.6 m)** non-cumulative.

27 3.5 CLEANING

28 A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system
29 members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

30 B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate
31 evidence of damage.

32 END OF SECTION 095113

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1 SECTION 096513 - RESILIENT BASE AND ACCESSORIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Thermoset-rubber base.
9 2. Rubber stair accessories.
10 3. Rubber molding accessories.

11 1.3 ACTION SUBMITTALS

- 12 A. Product Data: For each type of product.

- 13 B. LEED Submittal:

14 Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

15
16 Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating
17 percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for
18 each product having recycled content.

19
20 Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with
21 requirements for regional materials, certificates indicating location of material manufacturer and point of
22 extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for
23 each regional material, and fraction by weight that is considered regional.

- 24 C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

- 25 D. Samples for Initial Selection: For each type of product indicated.

- 26 E. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in
27 manufacturer's standard-size Samples, but not less than 12 inches (300 mm) long.

- 28 F. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

29 1.4 MAINTENANCE MATERIAL SUBMITTALS

- 30 A. Furnish extra materials **from the same product run** that match products installed and that are packaged with
31 protective covering for storage and identified with labels describing contents.

- 32 1. Furnish not less than [10 linear feet (3 linear m)] for every [500 linear feet (150 linear m)] or fraction thereof,
33 of each type, color, pattern, and size of resilient product installed.

- 1 1.5 DELIVERY, STORAGE, AND HANDLING
- 2 A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient
3 temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or
4 more than 90 deg F (32 deg C).
- 5 1.6 FIELD CONDITIONS
- 6 A. Maintain ambient temperatures within range recommended by manufacturer, but not less than [70 deg F (21
7 deg C) or more than [95 deg F (35 deg C) , in spaces to receive resilient products during the following periods:
- 8 1. 48 hours before installation.
9 2. During installation.
10 3. 48 hours after installation.
- 11 B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by
12 manufacturer, but not less than [55 deg F (13 deg C) or more than [95 deg F (35 deg C).
- 13 C. Install resilient products after other finishing operations, including painting, have been completed.

14 PART 2 - PRODUCTS

15 2.1 RESILIENT BASE

- 16 A. Recycled Content of Rubber Products: Postconsumer recycled content plus one-half of preconsumer recycled
17 content not less than 60 percent.
- 18 B. Basis of Design: Subject to compliance with requirements, provide Roppe Corporation, USA or comparable product
19 by one of the following:
20
- 21 1. Allstate Rubber Corp.; Stoler Industries.
22 2. Armstrong World Industries, Inc.
23 3. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
24 4. Endura Rubber Flooring; Division of Burke Industries, Inc.
25 5. Estrie Products International; American Biltrite (Canada) Ltd.
26 6. Flexco, Inc.
27 7. Johnsonite.
28 8. Mondo Rubber International, Inc.
29 9. Musson, R. C. Rubber Co.
30 10. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
31 11. PRF USA, Inc.
32 12. VPI, LLC; Floor Products Division.

33 2.2 THERMOSET-RUBBER BASE

- 34 A. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
35 1. RB-1
36 2. Manufacturer: Roppe
37 3. Style: 4" Cove
38 4. Color: 123 Charcoal
39 5. Lengths: Coils in manufacturer's standard length
40 6. Outside Corners: **Job formed**
41 7. Inside Corners: **Job formed**

- 1 B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
2 1. RB-2
3 2. Manufacturer: Roppe
4 3. Style: 4" Straight
5 4. Color: 193 Black Brown
6 5. Lengths: Coils in manufacturer's standard length
7 6. Outside Corners: **Job formed**
8 7. Inside Corners: **Job formed**

- 9 C. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
10 1. RB-3
11 2. Manufacturer: Roppe
12 3. Style: Pinnacle Plus #65 Profile 4 5/8"
13 4. Color: 193 Black Brown
14 5. Lengths: Coils in manufacturer's standard length
15 6. Outside Corners: **Job formed**
16 7. Inside Corners: **Job formed**

17 2.3 RUBBER STAIR ACCESSORIES

- 18 A. Basis of Design: Subject to compliance with requirements, provide Nora Rubber Flooring; Freudenberg Building
19 Systems, Inc. or comparable product by one of the following:
20

- 21 1. Allstate Rubber Corp.; Stoler Industries.
22 2. Armstrong World Industries, Inc.
23 3. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
24 4. Endura Rubber Flooring; Division of Burke Industries, Inc.
25 5. Estrie Products International; American Biltrite (Canada) Ltd.
26 6. Flexco, Inc.
27 7. Johnsonite.
28 8. Mondo Rubber International, Inc.
29 9. Musson, R. C. Rubber Co.
30 10. PRF USA, Inc.
31 11. Roppe Corporation, USA
32 12. VPI, LLC; Floor Products Division.

- 33 B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or
34 NFPA 253 by a qualified testing agency.

- 35 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

- 36 C. Stair Treads: ASTM F 2169.
37 1. RT-1
38 2. Manufacturer: Nora Systems
39 3. Style: Norament Grano Stairtreads
40 4. Color: Banded Agate 4882
41 5. Size: Lengths and depths to fit each stair tread in **one piece**
42 6. Integral Risers: Smooth, flat; in height that fully covers substrate.

- 43 D. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers, produced by same
44 manufacturer as treads, and recommended by manufacturer for installation with treads.

- 45 1. Thickness: **Manufacturer's standard**

- 46 E. Landing Tile: See finish schedule

- 1 2.4 RUBBER MOLDING ACCESSORY
- 2 A. Description: Rubber **decorative moldings (CH-1)**
- 3 B. Basis of Design: Subject to compliance with requirements, provide Johnsonite or comparable product by one of the
4 following:
5
- 6 1. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
7 2. Flexco, Inc.
8 3. R.C.A. Rubber Company (The).
9 4. Roppe Corporation, USA.
10 5. VPI Corporation.
- 11 C. Profile and Dimensions: Provide manufacturers standards and as provided below:
12 1. Manufacturer: Johnsonite
13 2. Style: CH-XX 3"x3/16"
14 3. Color: 44 Dark Brown
- 15 D. Locations: As indicated on drawings
- 16 E. Description: Transition strips
- 17 F. Basis of Design: Subject to compliance with requirements, provide Johnsonite or comparable product by one of the
18 following:
19
- 20 1. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
21 2. Flexco, Inc.
22 3. R.C.A. Rubber Company (The).
23 4. Roppe Corporation, USA.
24 5. VPI Corporation.
- 25 G. Locations: Between carpet and resilient flooring installations, carpet and concrete installations, resilient flooring
26 and concrete installations, resilient flooring and resilient flooring installations (thickness variations).
- 27 H. Colors and Patterns: to be selected from manufacturer's standards
- 28 2.5 INSTALLATION MATERIALS
- 29 A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-
30 cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- 31 B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and
32 substrate conditions indicated..
33
- 34 1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59,
35 Subpart D (EPA Method 24).
36 2. Adhesives shall have a VOC content of 60 g/L or less for rubber products.
- 37 C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing
38 substrates that do not conform to tread contours.
- 39 D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

3 A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and
4 other conditions affecting performance of the Work.

5 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections
6 and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere
7 with adhesion of resilient products.

8 B. Proceed with installation only after unsatisfactory conditions have been corrected.

9 1. Installation of resilient products indicates acceptance of surfaces and conditions.

10 3.2 PREPARATION

11 A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

12 B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710.

13 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

14 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain
15 soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

16 3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation
17 only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but
18 not less than 5 or more than [9 pH.

19 4. Moisture Testing: Must be performed per manufacturers recommendations, at minimum each test area
20 does not exceed [200 sq. ft. (18.6 sq. m)] and perform no fewer than three tests in each installation area and
21 with test areas evenly spaced in installation areas.

22 Utilize testing method recommended by manufacturer:

23 a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have
24 maximum moisture-vapor-emission rate of [3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)
25 in 24 hours.

26 b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after
27 substrates have a maximum 75 percent relative humidity level measurement.

28 C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps
29 and ridges to produce a uniform and smooth substrate.

30 D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

31 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces
32 where they will be installed.

33 E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

34 3.3 RESILIENT BASE INSTALLATION

35 A. Comply with manufacturer's written instructions for installing resilient base.

36 B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures
37 in rooms and areas where base is required.

- 1 C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- 2 D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with
3 horizontal and vertical substrates.
- 4 E. Do not stretch resilient base during installation.
- 5 F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with
6 manufacturer's recommended adhesive filler material.
- 7 G. Preformed Corners: Install preformed corners before installing straight pieces.
- 8 H. Job-Formed Corners:
- 9 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than [3
10 inches (76 mm)] in length.
- 11 a. Form without producing discoloration (whitening) at bends.
- 12 b. Millwork shaped base must have mitered corners
- 13 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than [3
14 inches (76 mm)] in length.
- 15 a. **Miter or cope** corners to minimize open joints.

16 3.4 RESILIENT ACCESSORY INSTALLATION

- 17 A. Comply with manufacturer's written instructions for installing resilient accessories.
- 18 B. Resilient Stair Accessories:
- 19 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
- 20 2. Tightly adhere to substrates throughout length of each piece.
- 21 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- 22 C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each
23 piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

24 3.5 CLEANING AND PROTECTION

- 25 A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- 26 B. Perform the following operations immediately after completing resilient-product installation:
- 27 1. Remove adhesive and other blemishes from surfaces.
- 28 2. Sweep and vacuum horizontal surfaces thoroughly.
- 29 3. Damp-mop horizontal surfaces to remove marks and soil.
- 30 C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and
31 placement of equipment and fixtures during remainder of construction period.
- 32 D. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

- 1 1. Apply manufacturer recommended number of coat(s).
- 2 E. Cover resilient products subject to wear and foot traffic until Substantial Completion.
- 3 END OF SECTION 096513

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1 SECTION 096516 - RESILIENT SHEET FLOORING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:
8 1. Unbacked rubber sheet flooring.

9 1.3 ACTION SUBMITTALS

- 10 A. Product Data: For each type of product.

- 11 B. LEED Submittals:
12 Product Data for Credit EQ 4.1: For adhesives including printed statement of VOC content.

13
14 Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating
15 percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for
16 each product having recycled content.

17
18 Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with
19 requirements for regional materials, certificates indicating location of material manufacturer and point of
20 extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for
21 each regional material, and fraction by weight that is considered regional.

- 22 C. Shop Drawings: For each type of resilient sheet flooring.

- 23 1. Include sheet flooring layouts, locations of seams and cutouts.
24 2. Show details of special patterns.

- 25 D. Samples for Verification: For each type of resilient sheet flooring, in manufacturer's standard size, but not less than
26 **6-by-9-inch (150-by-230-mm)** sections of each color, texture, and pattern required.

27 1.4 INFORMATIONAL SUBMITTALS

- 28 A. Qualification Data: For Installer.

29 1.5 CLOSEOUT SUBMITTALS

- 30 A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

- 1 1.6 MAINTENANCE MATERIAL SUBMITTALS
- 2 A. Furnish extra materials, **from the same product run**, that match products installed and that are packaged with
3 protective covering for storage and identified with labels describing contents.
- 4 1. Resilient Sheet Flooring: Furnish not less than **10 linear feet (3 linear m)** for every **500 linear feet (150**
5 **linear m)** or fraction thereof, in roll form and in full roll width for each type, color, and pattern of flooring
6 installed.
- 7 1.7 QUALITY ASSURANCE
- 8 A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required
9 by manufacturer for resilient sheet flooring installation and seaming method indicated.
- 10 1. Engage an installer who employs workers for this Project who are trained or certified by resilient sheet
11 flooring manufacturer for installation techniques required.
- 12 1.8 DELIVERY, STORAGE, AND HANDLING
- 13 A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient
14 temperatures maintained within range recommended by manufacturer, but not less than **50 deg F (10 deg C)** or
15 more than **90 deg F (32 deg C)**. Store rolls upright.
- 16 1.9 FIELD CONDITIONS
- 17 A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **65 deg F** or more
18 than **80 deg F** in spaces to receive resilient sheet flooring during the following periods:
- 19 1. 48 hours before installation.
20 2. During installation.
21 3. 48 hours after installation.
- 22 B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by
23 manufacturer, but not less than **55 deg F (13 deg C)** or more than **95 deg F (35 deg C)**
- 24 C. Close spaces to traffic during resilient sheet flooring installation.
- 25 D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.
- 26 E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.
- 27 PART 2 - PRODUCTS
- 28 2.1 PERFORMANCE REQUIREMENTS
- 29 A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products
30 according to ASTM E 648 or NFPA 253 by a qualified testing agency.
- 31 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1 B. Recycled Content of Rubber Products: Postconsumer recycled content plus one-half of preconsumer recycled
2 content not less than 60 percent.

3 2.2 UNBACKED RUBBER SHEET FLOORING

4 A. Basis-of-Design Product: Subject to compliance with requirements, provide Atmosphere Recycled Rubber Flooring
5 or comparable product by one of the following:

- 6
- 7 1. Altro Group.
- 8 2. Amtico Studio (The), Amtico International Inc.
- 9 3. Armstrong World Industries, Inc.
- 10 4. Burke Mercer Flooring Products, Division of Burke Industries Inc.
- 11 5. Estrie Products International, American Biltrite (Canada) Ltd.
- 12 6. Flexco.
- 13 7. Gemtec Inc.
- 14 8. Gerflor, Architectural Floor Systems, Inc.
- 15 9. Johnsonite.
- 16 10. Polyflor, Ltd., Distributed by Gerbert Limited.
- 17 11. Roppe Corporation, USA.
- 18 12. Tarkett, Inc.
- 19 13. TOLI International.
- 20 14. VPI, LLC, Floor Products Division.

21 B. Product Standard: ASTM F 1859.

22 C. RS-4

- 23 1. Manufacturer: Atmosphere Recycled Rubber Flooring
- 24 2. Style: Structure
- 25 3. Color: TM904 Elemental Grey
- 26 4. Thickness: 10mm Roll
- 27 5. Sheet Width: **4.0 feet (1.2 m)**

28 D. RS-5

- 29 1. Manufacturer: Atmosphere Recycled Rubber Flooring
- 30 2. Style: Structure
- 31 3. Color: TM908 Tunisian Blue
- 32 4. Thickness: 10mm Roll
- 33 5. Sheet Width: **4.0 feet (1.2 m)**

34 2.3 INSTALLATION MATERIALS

35 A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-
36 cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

37 B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and
38 substrate conditions indicated.

- 39
- 40 1. Use adhesives that comply with the following limits for VOC content when calculated according to
41 40 CFR 59, Subpart D (EPA Method 24).
- 42 2. VCT and Asphalt tile Adhesives: Not more than of 50 g/L or less.
- 43 3. Rubber Floor Adhesives: Not more than of 60 g/L or less.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

- 3 A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and
4 other conditions affecting performance of the Work.
- 5 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections
6 and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere
7 with adhesion of resilient sheet flooring.
- 8 B. Proceed with installation only after unsatisfactory conditions have been corrected.

9 3.2 PREPARATION

- 10 A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of
11 resilient sheet flooring.
- 12 B. Concrete Substrates: Prepare according to ASTM F 710.
- 13 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
14 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain
15 soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring
16 manufacturer. Do not use solvents.
17 3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer.
18 Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by
19 manufacturer in writing, but not less than 5 or more than 9 pH.
20 4. Moisture Testing: Perform tests so that each test area does not exceed **200 sq. ft. (18.6 sq. m)** and perform
21 no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
- 22 a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have
23 maximum moisture-vapor-emission rate of **[3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**
24 in 24 hours.
- 25 C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps
26 and ridges to produce a uniform and smooth substrate.
- 27 D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be
28 installed.
- 29 1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they
30 will be installed.
- 31 E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

32 3.3 RESILIENT SHEET FLOORING INSTALLATION

- 33 A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- 34 B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.
- 35 C. Lay out resilient sheet flooring as follows:
- 36 1. Maintain uniformity of flooring direction.

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1 SECTION 096519 - RESILIENT TILE FLOORING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:
8 1. Rubber floor tile.

9 1.3 ACTION SUBMITTALS

- 10 A. Product Data: For each type of product.

- 11 B. LEED Submittals:
12 Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.

13
14 Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating
15 percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for
16 each product having recycled content.

17
18 Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with
19 requirements for regional materials, certificates indicating location of material manufacturer and point of
20 extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for
21 each regional material, and fraction by weight that is considered regional.

- 22 C. Shop Drawings: For each type of resilient floor tile.

- 23 1. Include floor tile layouts and cutouts.
24 2. Show details of special patterns.

- 25 D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

- 26 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than **9 inches (230 mm)** long, of
27 each color required.

28 1.4 INFORMATIONAL SUBMITTALS

- 29 A. Qualification Data: For Installer.

30 1.5 CLOSEOUT SUBMITTALS

- 31 A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

- 1 1.6 MAINTENANCE MATERIAL SUBMITTALS
- 2 A. Furnish extra materials, **from the same product run**, that match products installed and that are packaged with
3 protective covering for storage and identified with labels describing contents.
- 4 1. Floor Tile: Furnish one box for every **50** boxes or fraction thereof, of each type, color, and pattern of floor
5 tile installed.
- 6 1.7 QUALITY ASSURANCE
- 7 A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required
8 by manufacturer for floor tile installation and seaming method indicated.
- 9 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile
10 manufacturer for installation techniques required.
- 11 1.8 DELIVERY, STORAGE, AND HANDLING
- 12 A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures
13 maintained within range recommended by manufacturer, but not less than **60 deg F** or more than **80 deg F**. Store
14 floor tiles on flat surfaces.
- 15 1.9 FIELD CONDITIONS
- 16 A. Maintain ambient temperatures within range recommended by manufacturer, but not less than **60 deg F** or more
17 than **80 deg F (35 deg C)** in spaces to receive floor tile during the following periods:
- 18 1. 48 hours before installation.
19 2. During installation.
20 3. 72 hours after installation.
- 21 B. Close spaces to traffic during floor tile installation.
- 22 C. Close spaces to traffic for 48 hours after floor tile installation.
- 23 D. Install floor tile after other finishing operations, including painting, have been completed.
- 24 PART 2 - PRODUCTS
- 25 2.1 PERFORMANCE REQUIREMENTS
- 26 A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to
27 ASTM E 648 or NFPA 253 by a qualified testing agency.
- 28 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- 29 B. Recycled Content of Rubber Products: Postconsumer recycled content plus one-half of preconsumer recycled
30 content not less than 60 percent.

- 1 2.2 Manufactures
- 2 A. Basis-of-Design Product: Subject to compliance with requirements, provide Nora Systems or comparable product
3 by one of the following:
4
- 5 1. Altro Group.
 - 6 2. Amtico Studio (The), Amtico International Inc.
 - 7 3. Armstrong World Industries, Inc.
 - 8 4. Burke Mercer Flooring Products, Division of Burke Industries Inc.
 - 9 5. Estrie Products International, American Biltrite (Canada) Ltd.
 - 10 6. Flexco.
 - 11 7. Gemtec Inc.
 - 12 8. Gerflor, Architectural Floor Systems, Inc.
 - 13 9. Johnsonite.
 - 14 10. Polyflor, Ltd., Distributed by Gerbert Limited.
 - 15 11. Roppe Corporation, USA.
 - 16 12. Tarkett, Inc.
 - 17 13. TOLI International.
 - 18 14. VPI, LLC, Floor Products Division.

19 2.3 RUBBER FLOOR TILE

- 20 A. RS-1 Rubber Floor (Grey)
- 21 1. Manufacturer: Nora Systems
 - 22 2. Style: Norament Grano
 - 23 3. Color: Hematite 4881
 - 24 4. Size: 40" x 40"
 - 25 5. Thickness: .14"

- 26 B. RS-2 Rubber Floor (Lt Blue)
- 27 1. Manufacturer: Nora Systems
 - 28 2. Style: Norament Grano
 - 29 3. Color: Zircon
 - 30 4. Size: 40" x 40"
 - 31 5. Thickness: .14"
- 32

- 33 C. RS-3 Rubber Floor (Red)
- 34 1. Manufacturer: Nora Systems
 - 35 2. Style: Norament Grano
 - 36 3. Color: Fire Opal
 - 37 4. Size: 40" x 40"
 - 38 5. Thickness: .14"

39 2.4 INSTALLATION MATERIALS

- 40 A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-
41 cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- 42 B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and
43 substrate conditions indicated.
44
- 45 1. Use adhesives that comply with the following limits for VOC content when calculated according to
46 40 CFR 59, Subpart D (EPA Method 24).
 - 47 2. VCT and Asphalt tile Adhesives: Not more than of 50 g/L or less.
 - 48 3. Rubber Floor Adhesives: Not more than of 60 g/L or less.

1

2 PART 3 - EXECUTION

3 3.1 EXAMINATION

4 A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and
5 other conditions affecting performance of the Work.

6 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections
7 and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere
8 with adhesion of floor tile.

9 B. Proceed with installation only after unsatisfactory conditions have been corrected.

10 3.2 PREPARATION

11 A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient
12 products.

13 B. Concrete Substrates: Prepare according to ASTM F 710.

14 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

15 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain
16 soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use
17 solvents.

18 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with
19 installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in
20 writing, but not less than 5 or more than

21 4. 9 pH.

22 5. Moisture Testing: Perform tests so that each test area does not exceed **200 sq. ft. (18.6 sq. m)** and perform
23 no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

24 a. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after
25 substrates have a maximum **75** percent relative humidity level measurement.

26 C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps
27 and ridges to produce a uniform and smooth substrate.

28 D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

29 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces
30 where they will be installed.

31 E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

32 3.3 FLOOR TILE INSTALLATION

33 A. Comply with manufacturer's written instructions for installing floor tile.

34 B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite
35 edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at
36 perimeter.

- 1 1. Lay tiles **square with room axis**
- 2 C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and
3 packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- 4 D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in
5 furniture, cabinets, pipes, outlets, and door frames.
- 6 E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door
7 openings.
- 8 F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on
9 floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- 10 G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in
11 installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and
12 adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- 13 H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed
14 installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks,
15 and other surface imperfections.
- 16 3.4 CLEANING AND PROTECTION
- 17 A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- 18 B. Perform the following operations immediately after completing floor tile installation:
- 19 1. Remove adhesive and other blemishes from surfaces.
20 2. Sweep and vacuum surfaces thoroughly.
21 3. Damp-mop surfaces to remove marks and soil.
- 22 C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of
23 equipment and fixtures during remainder of construction period.
- 24 D. Cover floor tile until Substantial Completion.
- 25 END OF SECTION 096519

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1 SECTION 096813 - TILE CARPETING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes modular carpet tile.

- 8 B. Related Requirements:

- 9 1. **Section 096513 "Resilient Base and Accessories" Section 096519 "Resilient Tile Flooring"** for resilient wall
10 base and accessories installed with carpet tile.

11 1.3 PREINSTALLATION MEETINGS

- 12 1. Review methods and procedures related to carpet tile installation including, but not
13 a. Review tile patterns and layout
14 b. Review subfloor preparation procedures.

15 1.4 ACTION SUBMITTALS

- 16 A. Product Data: For each type of product.

- 17 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
18 2. Include manufacturer's written installation recommendations for each type of substrate.

- 19 B. LEED Submittals:

20 Product Data for Credit EQ 4.3:

- 21 For carpet tile, documentation indicating compliance with testing and product requirements of CRI's "Green
22 Label Plus" program.

- 23 C. For installation adhesive, documentation including printed statement of VOC content.

- 24 D. Shop Drawings: For carpet tile installation, plans showing the following:

- 25 1. Carpet tile type, color, and dye lot.
26 2. Pattern of installation.
27 3. Pattern type, location, and direction.
28 4. Type, color, and location of insets and borders.
29 5. Type, color, and location of edge, transition, and other accessory strips.
30 6. Transition details to other flooring materials.

- 31 E. Samples: For each of the following products and for each color and texture required. Label each Sample with
32 manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

- 33 1. Carpet Tile: Full-size Sample.
34 2. Exposed Edge, Transition, and Other Accessory Stripping: **12-inch- (300-mm-)** long Samples.

- 1 F. Samples for Initial Selection: For each type of carpet tile.
- 2 1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish
3 selection.
- 4 G. Product Schedule: For carpet tile. Use same designations indicated on Drawings.
- 5 H. Sustainability: Provide the Statement of the Achievement Level the carpet has attained for Silver, 37 to 51points,
6 based on specific Sustainable Attribute Performance for all product stages according to ANSI/NSF 140.
- 7 1.5 INFORMATIONAL SUBMITTALS
- 8 A. Qualification Data: For Installer.
- 9 B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- 10 C. Sample Warranty: For special warranty.
- 11 1.6 CLOSEOUT SUBMITTALS
- 12 A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
- 13 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and
14 manufacturer's recommended maintenance schedule.
- 15 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.
- 16 1.7 MAINTENANCE MATERIAL SUBMITTALS
- 17 A. Furnish extra materials, from the same product run, that match products installed and that are packaged with
18 protective covering for storage and identified with labels describing contents.
- 19 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than
20 10 sq. yd. (8.3 sq. m).
- 21 1.8 QUALITY ASSURANCE
- 22 A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering
23 Installers Association at the **Commercial II** certification level.
- 24 1.9 DELIVERY, STORAGE, AND HANDLING
- 25 A. Comply with CRI's "CRI Carpet Installation Standard."
- 26 1.10 FIELD CONDITIONS
- 27 A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- 28 B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-
29 work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels
30 planned for building occupants during the remainder of the construction period..

1 C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive
2 and concrete slabs have pH range recommended by carpet tile manufacturer.

3 D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles
4 before installing these items.

5 1.11 WARRANTY

6 A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation
7 that fail in materials or workmanship within specified warranty period.

8 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate,
9 vandalism, or abuse.

10 2. Failures include, but are not limited to, the following:

11 a. More than 10 percent edge raveling, snags, and runs.

12 b. Dimensional instability.

13 c. Excess static discharge.

14 d. Loss of tuft-bind strength.

15 e. Loss of face fiber.

16 f. Delamination.

17 3. Warranty Period: **10** years from date of Substantial Completion.

18 4. See manufacturer specific warranty information

19 PART 2 - PRODUCTS

20 2.1 CARPET TILE

21 A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or preapproved
22 comparable product.

23 B. Style name and color: As selected by Architect.

24 C. Size: As indicated.

25 D. Installation As indicated.

26 E. Recycled Content: 40% in backing, 25% in nylon fiber.

27 2.2 CARPET TILE

28 A. CPT-1

29 1. Manufacturer: Milliken

30 2. Collection: Color Field Patina

31 3. Color: PAT145-124 Bark

32 4. Installation: Offset Random

33 5. Size: 25cmx1m

34 6. Backing: Standard – PVC-Free Underscore ES Cushion

35 B. CPT-2

36 1. Manufacturer: Milliken

- 1 2. Style: Color Field Patina
- 2 3. Color: PAT249-52 Billon
- 3 4. Installation: Offset Random
- 4 5. Size: 25cmx1m
- 5 6. Backing: Standard – PVC-Free Underscore ES Cushion

- 6 C. CPT-3
- 7 1. Manufacturer: Tandus
- 8 2. Style: Triptych 04331
- 9 3. Color: Fired Earth 76006
- 10 4. Installation: Vertical Ashlar
- 11 5. Size: 24"x24"
- 12 6. Backing: ER3

- 13 D. CPT-4
- 14 1. Manufacturer: Mohawk Group
- 15 2. Style: Step In Style II
- 16 3. Color: Iron Ore 983
- 17 4. Installation: Monolithic
- 18 5. Size: 24"x24"
- 19 6. Backing: EcoFlex ICT

20 2.3 INSTALLATION ACCESSORIES

- 21 A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or
- 22 recommended by carpet tile manufacturer.
- 23 B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor
- 24 conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by
- 25 carpet tile manufacturer for releasable installation.
- 26
- 27 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D
- 28 (EPA Method 24).

29 PART 3 - EXECUTION

30 3.1 EXAMINATION

- 31 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum
- 32 moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- 33 B. Examine carpet tile for type, color, pattern, and potential defects.
- 34 C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete"
- 35 and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
- 36 1. Moisture Testing: Perform tests so that each test area does not exceed **200 sq. ft. (18.6 sq. m)** and perform
- 37 no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
- 38 a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have
- 39 maximum moisture-vapor-emission rate of **3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m)**
- 40 in 24 hours.
- 41 b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after
- 42 substrates have a maximum **75** percent relative humidity level measurement.

1 c. Perform additional moisture tests recommended in writing by adhesive and carpet tile
2 manufacturers. Proceed with installation only after substrates pass testing.

3 D. Proceed with installation only after unsatisfactory conditions have been corrected.

4 3.2 PREPARATION

5 A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation
6 instructions for preparing substrates indicated to receive carpet tile.

7 B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks,
8 holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions **1/8 inch (3 mm)** wide or
9 wider, and protrusions more than **1/32 inch (0.8 mm)** unless more stringent requirements are required by
10 manufacturer's written instructions.

11 C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible
12 with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods
13 recommended in writing by adhesive and carpet tile manufacturers.

14 D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

15 3.3 INSTALLATION

16 A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile
17 manufacturer's written installation instructions.

18 B. Installation Method: **As recommended in writing by carpet tile manufacturer**

19 C. Maintain dye-lot integrity. Do not mix dye lots in same area.

20 D. Maintain pile-direction patterns **indicated on Drawings**

21 E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including
22 cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile
23 manufacturer.

24 F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves,
25 and similar openings.

26 G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on
27 carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

28 H. Install pattern parallel to walls and borders.

29 3.4 CLEANING AND PROTECTION

30 A. Perform the following operations immediately after installing carpet tile:

31 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile
32 manufacturer.

33 2. Remove yarns that protrude from carpet tile surface.

34 3. Vacuum carpet tile using commercial machine with face-beater element.

- 1 B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor
2 Installations."
- 3 C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during
4 the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile
5 manufacturer.
- 6 END OF SECTION 096813

1 SECTION 097200 - WALL COVERINGS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Vinyl wall covering.

- 9 B. Related Sections:

- 10 1. Section 099113 "Interior Painting" for priming wall surfaces.

11 1.3 ACTION SUBMITTALS

- 12 A. Product Data: For each type of product.

- 13 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

- 14 B. LEED Submittals

- 15
16 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation
17 indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement
18 indicating cost for each product having recycled content.
19 2. Product Certificates for Credit MR 5.1: For products and materials required to comply with requirements
20 for regionally manufactured materials. Include statement indicating cost, location of manufacturer, and
21 distance to Project for each regionally manufactured material.
22 3. Product Data for Credit EQ 4.1: For installation adhesives, documentation including printed statement of
23 VOC content and chemical components.

- 24 C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-
25 inch- (914-mm-) long in size.

- 26 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments
27 applied. Show complete pattern repeat. Mark top and face of fabric.

28 1.4 CLOSEOUT SUBMITTALS

- 29 A. Maintenance Data: For wall coverings to include in maintenance manuals.

1 1.5 MAINTENANCE MATERIAL SUBMITTALS

2 A. Furnish extra materials, from the same product run, that match products installed and that are packaged with
3 protective covering for storage and identified with labels describing contents.

4 1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 10 percent
5 of amount installed.

6 1.6 FIELD CONDITIONS

7 A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet
8 work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and
9 maintaining ambient temperature and humidity conditions at levels intended for occupants after Project
10 completion during the remainder of the construction period.

11 B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project
12 completion is provided on the surfaces to receive wall covering.

13 C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-
14 covering manufacturer for full drying or curing.

15 PART 2 - PRODUCTS

16 2.1 PERFORMANCE REQUIREMENTS

17 A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical
18 adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products
19 with appropriate markings of applicable testing agency.

20 1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify
21 products with appropriate markings of applicable testing agency.

- 22 a. Flame-Spread Index: 25 or less.
- 23 b. Smoke-Developed Index: 50 or less.

24 2.2 VINYL WALL COVERING (VWC)

25 A. Products:

- 26 1. VWC-1
 - 27 a. Distributor: DL Couch
 - 28 b. Manufacturer: Versa Guard Wall Protection
 - 29 c. Style: Halcyon
 - 30 d. Color: Scandia TYP3-127319

- 31 2. VWC -2
 - 32 a. Distributor: Wolf Gordon
 - 33 b. Manufacturer: Rampart
 - 34 c. Style: Sparta
 - 35 d. Color: Espresso

36 B. Description: Provide products in rolls from same production run and complying with the following:

1 1. FS CCC-W-408D and CFFA-W-101-D for Type II, Medium-Duty products.

2 2.3 ACCESSORIES

3 A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate
4 application indicated and as recommended in writing by wall-covering manufacturer.

5 1. Adhesive shall have a VOC content of 50 g/L or less.

6 B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and
7 recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

8 PART 3 - EXECUTION

9 3.1 EXAMINATION

10 A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall
11 plumbness, maximum moisture content, and other conditions affecting performance of the Work.

12 B. Proceed with installation only after unsatisfactory conditions have been corrected.

13 3.2 PREPARATION

14 A. Comply with manufacturer's written instructions for surface preparation.

15 B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and
16 incompatible primers.

17 C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings,
18 cracks, and defects.

19 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when
20 tested with an electronic moisture meter.

21 2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-
22 covering manufacturer.

23 D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

24 E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

25 F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24
26 hours before installation.

27 3.3 WALL-COVERING INSTALLATION

28 A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications
29 indicated.

30 B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

31 C. Install strips in same order as cut from roll.

- 1 D. Install wall covering without lifted or curling edges and without visible shrinkage.
- 2 E. Match pattern 72 inches (1830 mm) above the finish floor.
- 3 F. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) from inside
4 corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- 5 G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps
6 between strips.
- 7 H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

8 3.4 CLEANING

- 9 A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- 10 B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- 11 C. Replace strips that cannot be cleaned.
- 12 D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

13 END OF SECTION 097200

1 SECTION 098433 – SOUND-ABSORBING WALL UNITS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:

- 8 1. Sound-absorbing wall panels.

9 1.3 DEFINITIONS

- 10 A. NRC: Noise Reduction Coefficient.

11 1.4 ACTION SUBMITTALS

- 12 A. Product Data: For each type of product.

- 13 1. Include **fabric facing**, panel edge, core material, and mounting indicated.

- 14 B. LEED Submittals:

15 Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating
16 percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for
17 each product having recycled content.

18
19 Product Certificates for Credit MR 5.1: For products and materials required to comply with requirements for
20 regionally manufactured materials. Include statement indicating cost, location of manufacturer, and distance to
21 Project for each regionally manufactured material.

22
23 Product Data for Credit EQ 4.1: For installation adhesives, documentation including printed statement of VOC
24 content and chemical components.

- 25 C. Shop Drawings: For unit assembly and installation.

- 26 1. Include plans, elevations, sections, and mounting devices and details.
27 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall
28 intersections. Indicate panel edge profile and core materials.
29 3. Include details at cutouts and penetrations for other work.
30 4. Include direction of fabric weave and pattern matching.

- 31 D. Samples for Initial Selection: For each type of fabric facing.

- 32 1. Include Samples of hardware and accessories involving color or finish selection.

- 33 E. Samples for Verification: For the following products:

- 1 1. Fabric.
 - 2 2. Panel Edge
 - 3 3. Core Material
 - 4 4. Mounting Devices.
- 5 1.5 INFORMATIONAL SUBMITTALS
- 6 A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and
 - 7 coordinated with each other, using input from installers of the items involved:
 - 8 1. Electrical outlets, switches, and thermostats.
 - 9 2. Items penetrating or covered by units
 - 10 B. Product Certificates: For each type of unit.
 - 11 C. Sample Warranty: For manufacturer's special warranty.
- 12 1.6 CLOSEOUT SUBMITTALS
- 13 A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturers' written
 - 14 cleaning and stain-removal instructions.
- 15 1.7 QUALITY ASSURANCE
- 16 A. Source Limitations: Obtain units from single source from single manufacturer.
- 17 1.8 DELIVERY, STORAGE, AND HANDLING
- 18 A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and
 - 19 humidity requirements for shipment, storage, and handling.
 - 20 B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air
 - 21 circulation.
- 22 1.9 FIELD CONDITIONS
- 23 A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is
 - 24 complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are
 - 25 maintained at the levels indicated for Project when occupied for its intended use.
 - 26 B. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units
 - 27 under conditions free from odor contamination of ambient air..
 - 28 C. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field
 - 29 measurements before fabrication, and indicate them on Shop Drawings.
- 30 1.10 WARRANTY
- 31 A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or
 - 32 workmanship within specified warranty period.

- 1 1. Failures include, but are not limited to the following:
- 2 a. Acoustical performance.
- 3 b. Fabric sagging, distorting, or releasing from panel edge.
- 4 c. Warping of core.
- 5 2. Warranty Period: **Two** years from date of Substantial Completion.

6 PART 2 - PRODUCTS

7 2.1 MANUFACTURERS

- 8 A. Source Limitations: Obtain wall units specified in this Section from single source from single manufacturer.

9 2.2 PERFORMANCE REQUIREMENTS

- 10 A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

- 13 1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

- 15 a. Flame-Spread Index: 25 or less.
- 16 b. Smoke-Developed Index: **450** or less.

- 17 2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265 Method B Protocol or NFPA 286.

19 2.3 SOUND-ABSORBING WALL UNITS

- 20 A. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material **stretched over front face of edge-framed core and bonded or attached to edges and back of frame**

- 22 B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- 24 1. [Acoustical Panel Systems \(APS, Inc.\)](#).
- 25 2. [Acoustical Solutions, Inc.](#)
- 26 3. [Armstrong World Industries](#).
- 27 4. [AVL Systems, Inc.](#)
- 28 5. [Benton Brothers Solutions, Inc.](#)
- 29 6. [Breitfus Acoustical Interiors](#).
- 30 7. [Conwed Designscape; an Owens Corning company](#).
- 31 8. [Decoustics Limited; a Saint Gobain company](#).
- 32 9. [Essi Acoustical Products](#).
- 33 10. [Golterman & Sabo](#).
- 34 11. [Lamvin, Inc.](#)
- 35 12. [MBI Products Company, Inc.](#)
- 36 13. [Panel Solutions, Inc.](#)
- 37 14. [Perdue Acoustics, Inc.](#)
- 38 15. [Pinta Acoustic, Inc.](#)
- 39 16. [Proudfoot Company, Inc. \(The\)](#).

- 1 17. [Sound Concepts Canada, Inc.](#)
2 18. [Sound Management Group LLC.](#)
3 19. [Tectum Inc.](#)
4 20. [Wall Technology, Inc.; an Owens Corning company.](#)
5 21. [Wenger Corporation.](#)
6 22. [Working Walls, Inc.](#)
- 7 a. Finish Color at Exposed Edges: **Match color of facing material**
- 8 23. Mounting: Back mounted with manufacturer's standard **adhesive** secured to substrate.
9 24. Core: **Manufacturer's standard**
- 10 a. Core-Face Layer: Manufacturer's standard
- 11 25. Edge Construction: Manufacturer's standard **chemically hardened core with no frame**
12 26. Corner Detail in Elevation: **Square** with continuous edge profile indicated.
13 27. Facing Material: **As indicated on Below**
14 28. Acoustical Performance: Sound absorption **NRC of 0.85** according to ASTM C 423
15 29. Nominal **Core** Thickness: **1 inch (25 mm)**
16 30. Panel Width: **As indicated on Drawings**
17 31. Panel Height: **As indicated on Drawings**
- 18 C. FWP Fabric Wrapped Acoustical Panel
19 1. FWP-1
20 2. Manufacturer: TBD
21 3. Style: 1" Thick Fabric Wrapped
22 4. Fabric: Maharam, Flock – 002 Course
23
24 1. FWP-2 Fabric Wrapped Acoustical Panel
25 2. Manufacturer: TBD
26 3. Style: 1" Thick Fabric Wrapped
27 4. Fabric: Maharam, Flock – 006 Briefcase
- 28 2.4 MATERIALS
- 29 A. General:
30
31 1. Minimum Recycled Content: Provide wall units with postconsumer recycled content plus one-half of
32 preconsumer recycled content of 25 percent by weight.
33 2. Regional Materials: Provide wall units that have been manufactured within **500 miles (800 km)** of Project
34 site.
- 35 B. Facing Material: Fabric from same dye lot; color and pattern.
- 36 C. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as
37 follows:
38
39 1. Adhesives: As recommended by wall unit manufacturer and with a VOC content of 70 g/L or less when
40 calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 41 2.5 FABRICATION
- 42 A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material
43 applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel
44 perimeter against warpage and damage.

- 1 B. Edge Hardening: For **glass-fiber board and mineral-fiber board** cores, chemically harden core edges and areas of
2 core where mounting devices are attached.
- 3 C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the
4 grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible
5 distortions or foreign matter.
- 6 1. Square Corners: Tailor corners.**Heat-seal vinyl fabric seams at corners.**
7 2. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in
8 same direction so pattern or weave matches in adjacent units.
- 9 D. Dimensional Tolerances of Finished Units: Plus or minus **1/16 inch (1.6 mm)** for the following:
- 10 1. Thickness.
11 2. Edge straightness.
12 3. Overall length and width.
13 4. Squareness from corner to corner.

14 PART 3 - EXECUTION

15 3.1 EXAMINATION

- 16 A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation
17 tolerances, and other conditions affecting unit performance.
- 18 B. Proceed with installation only after unsatisfactory conditions have been corrected.

19 3.2 INSTALLATION

- 20 A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb,
21 top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders
22 and at penetrations.
- 23 B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated.
24 Mount units securely to supporting substrate.
- 25 C. Align fabric pattern and grain **with adjacent units**

26 3.3 INSTALLATION TOLERANCES

- 27 A. Variation from Plumb and Level: Plus or minus **1/16 inch (1.6 mm)** in **48 inches (1200 mm)**, noncumulative.
- 28 B. Variation of Joint Width: Not more than **1/16-inch (1.6-mm)** [**1/32-inch (0.79-mm)** variation from **hairline** in **48**
29 **inches (1200 mm)**, noncumulative.

30 3.4 CLEANING

- 31 A. Clip loose threads; remove pills and extraneous materials.
- 32 B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's
33 written instructions.

34 END OF SECTION 098433

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1 SECTION 099113 - EXTERIOR PAINTING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes surface preparation and the application of paint systems on **exterior substrates**.

8 B. Related Requirements:

- 9 1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
10 2. Section 055113 "Metal Pan Stairs"
11 3. Section 055213 "Pipe and Tube Railings" for shop **priming** pipe and tube railings.
12 4. Section 099123 "Interior Painting"

13 1.3 DEFINITIONS

- 14 A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

- 15 B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

- 16 C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

- 17 D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

- 18 E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

- 19 F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

20 1.4 ACTION SUBMITTALS

- 21 A. Product Data: For each type of product. Include preparation requirements and application instructions.

- 22 1. Include printout of current "MPI Approved Products List" for each product category specified, with the
23 proposed product highlighted.
24 2. Indicate VOC content.

- 25 B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

- 26 1. Submit Samples on rigid backing, **8 inches (200 mm)** square.
27 2. Apply coats on Samples in steps to show each coat required for system.
28 3. Label each coat of each Sample.
29 4. Label each Sample for location and application area.

- 30 C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on
31 Drawings and in schedules. Include color designations.

1 1.5 MAINTENANCE MATERIAL SUBMITTALS

2 A. Furnish extra materials, **from the same product run**, that match products installed and that are packaged with

3 protective covering for storage and identified with labels describing contents.

4 1. Paint: 5 percent, but not less than **1 gal. (3.8 L)** of each material and color applied.

5 1.6 DELIVERY, STORAGE, AND HANDLING

6 A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures

7 continuously maintained at not less than **45 deg F (7 deg C)**.

8 1. Maintain containers in clean condition, free of foreign materials and residue.

9 2. Remove rags and waste from storage areas daily.

10 1.7 FIELD CONDITIONS

11 A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and**

12 **95 deg F (10 and 35 deg C)**.

13 B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less

14 than **5 deg F (3 deg C)** above the dew point; or to damp or wet surfaces.

15 PART 2 - PRODUCTS

16 2.1 MANUFACTURERS

17 A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be

18 incorporated into the Work include, but are not limited to the following:

- 19 1. [Behr Process Corporation.](#)
- 20 2. [Benjamin Moore & Co.](#)
- 21 3. [California Paints.](#)
- 22 4. [Conco Paints.](#)
- 23 5. [Coronado Paint; Benjamin Moore Company.](#)
- 24 6. [Diamond Vogel Paints.](#)
- 25 7. [Dulux \(formerly ICI Paints\); a brand of AkzoNobel.](#)
- 26 8. [Dunn-Edwards Corporation.](#)
- 27 9. [Duron, Inc.](#)
- 28 10. [Frazee Paint; Comex Group.](#)
- 29 11. [Glidden Professional.](#)
- 30 12. [Kelly-Moore Paint Company Inc.](#)
- 31 13. [Kwal Paint; Comex Group.](#)
- 32 14. [M.A.B. Paints.](#)
- 33 15. [McCormick Paints.](#)
- 34 16. [Parker Paint; Comex Group.](#)
- 35 17. [PPG Architectural Coatings.](#)
- 36 18. [Pratt & Lambert.](#)
- 37 19. [Rodda Paint Co.](#)
- 38 20. [Rust-Oleum Corporation; a subsidiary of RPM International, Inc.](#)
- 39 21. [Sherwin-Williams Company \(The\).](#)
- 40 22. [Valspar Corporation - Architectural \(Pro\).](#)
- 41 23. [Vista Paint Corporation.](#)

- 1 24. Zinsser; Rust-Oleum Corporation.
- 2 B. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work**
- 3 **include, but are not limited to products** listed in the Exterior Painting Schedule for the paint category indicated.
- 4 2.2 PAINT, GENERAL
- 5 A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved
- 6 Products Lists."
- 7 B. Material Compatibility:
- 8 1. Materials for use within each paint system shall be compatible with one another and substrates indicated,
- 9 under conditions of service and application as demonstrated by manufacturer, based on testing and field
- 10 experience.
- 11 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for
- 12 use in paint system and on substrate indicated.
- 13 C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- 14 D. Colors: **As indicated in color schedule**

15 PART 3 - EXECUTION

16 3.1 EXAMINATION

- 17 A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum
- 18 moisture content and other conditions affecting performance of the Work.
- 19 B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- 20 C. Proceed with coating application only after unsatisfactory conditions have been corrected.
- 21 1. Application of coating indicates acceptance of surfaces and conditions.

22 3.2 PREPARATION

- 23 A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification
- 24 Manual" applicable to substrates and paint systems indicated.
- 25 B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If
- 26 removal is impractical or impossible because of size or weight of item, provide surface-applied protection before
- 27 surface preparation and painting.
- 28 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were
- 29 removed. Remove surface-applied protection.
- 30 C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible
- 31 paints and encapsulants.
- 32 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required
- 33 to produce paint systems indicated.

- 1 D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if
 2 moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written
 3 instructions.
- 4 E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of
 5 surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- 6 F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in
 7 writing by paint manufacturer **but not less than the following:**
 8 1. SSPC-SP 3.
- 9 G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint
 10 exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-
 11 primed surfaces.
- 12 H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods
 13 to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

14 3.3 APPLICATION

- 15 A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting
 16 Specification Manual."
- 17 1. Use applicators and techniques suited for paint and substrate indicated.
 18 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint
 19 surfaces behind permanently fixed items with prime coat only.
 20 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 21 4. Paint entire exposed surface of window frames and sashes.
 22 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance
 23 rating, or nomenclature plates.
 24 6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished
 25 if acceptable to topcoat manufacturers.
- 26 B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each
 27 coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to
 28 distinguish each separate coat.
- 29 C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint
 30 finish, color, and appearance.
- 31 D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs,
 32 sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

33 3.4 FIELD QUALITY CONTROL

- 34 A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect
 35 and test paint for dry film thickness.
- 36 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 37 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's
 38 written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide
 39 dry film thickness that complies with paint manufacturer's written recommendations.

- 1 3.5 CLEANING AND PROTECTION
- 2 A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 3 B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or
4 other methods. Do not scratch or damage adjacent finished surfaces.
- 5 C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by
6 cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- 7 D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- 8 3.6 EXTERIOR PAINTING SCHEDULE
- 9 A. Steel and Iron Substrates:
- 10 1. Quick-Dry Enamel System:
- 11 a. Prime Coat: Primer, alkyd, quick dry, for metal, **MPI #76**.
- 12 b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- 13 c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5), **MPI #81**.
- 14 END OF SECTION 099113

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1 SECTION 099123 - INTERIOR PAINTING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes surface preparation and the application of paint systems on **following interior substrates:**

- 8 1. Concrete.
9 2. Concrete masonry units (CMUs).
10 3. Steel.
11 4. Gypsum board.

- 12 B. Related Requirements:

- 13 1. Section 055113 "Metal Pan Stairs" for shop priming metal pan stairs.
14 2. Section 055213 "Pipe and Tube Railings" for shop **[priming] [painting]** pipe and tube railings.
15 3. Section 099113 "Exterior Painting"
16 4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood
17 stains and transparent finishes on interior wood substrates.

18 1.3 DEFINITIONS

- 19 A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
20 B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
21 C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
22 D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
23 E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
24 F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
25 G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

26 1.4 ACTION SUBMITTALS

- 27 A. Product Data: For each type of product. Include preparation requirements and application instructions.
28 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the
29 proposed product highlighted.
30 2. Indicate VOC content.
31 B. LEED Submittals:

- 1 Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
2
3 Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with
4 requirements for regional materials, certificates indicating location of material manufacturer and point of
5 extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for
6 each regional material, and fraction by weight that is considered regional.
- 7 C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
- 8 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
9 2. Apply coats on Samples in steps to show each coat required for system.
10 3. Label each coat of each Sample.
11 4. Label each Sample for location and application area.
- 12 D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on
13 Drawings and in schedules. Include color designations.
- 14 1.5 MAINTENANCE MATERIAL SUBMITTALS
- 15 A. Furnish extra materials, **from the same product run**, that match products installed and that are packaged with
16 protective covering for storage and identified with labels describing contents.
- 17 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.
- 18 1.6 DELIVERY, STORAGE, AND HANDLING
- 19 A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures
20 continuously maintained at not less than 45 deg F (7 deg C).
- 21 1. Maintain containers in clean condition, free of foreign materials and residue.
22 2. Remove rags and waste from storage areas daily.
- 23 1.7 FIELD CONDITIONS
- 24 A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and
25 95 deg F (10 and 35 deg C).
- 26 B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above
27 the dew point; or to damp or wet surfaces.
- 28 PART 2 - PRODUCTS
- 29 2.1 MANUFACTURERS
- 30 A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be
31 incorporated into the Work include, but are not limited to the following:
- 32 1. Behr Process Corporation.
33 2. Benjamin Moore & Co.
34 3. California Paints.
35 4. Conco Paints.
36 5. Coronado Paint; Benjamin Moore Company.

- 1 6. [Diamond Vogel Paints.](#)
- 2 7. [Dulux \(formerly ICI Paints\); a brand of AkzoNobel.](#)
- 3 8. [Dunn-Edwards Corporation.](#)
- 4 9. [Duron, Inc.](#)
- 5 10. [Frazee Paint; Comex Group.](#)
- 6 11. [Glidden Professional.](#)
- 7 12. [Kelly-Moore Paint Company Inc.](#)
- 8 13. [Kwal Paint; Comex Group.](#)
- 9 14. [M.A.B. Paints.](#)
- 10 15. [McCormick Paints.](#)
- 11 16. [Parker Paint; Comex Group.](#)
- 12 17. [PPG Architectural Coatings.](#)
- 13 18. [Pratt & Lambert.](#)
- 14 19. [Rodda Paint Co.](#)
- 15 20. [Rust-Oleum Corporation; a subsidiary of RPM International, Inc.](#)
- 16 21. [Sherwin-Williams Company \(The\).](#)
- 17 22. [United Gilsonite Laboratories.](#)
- 18 23. [Valspar Corporation - Architectural \(Pro\).](#)
- 19 24. [Vista Paint Corporation.](#)
- 20 25. [Zinsser; Rust-Oleum Corporation.](#)

21 B. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work**
 22 **include, but are not limited to products** listed in the Interior Painting Schedule for the paint category indicated.

23 2.2 PAINT, GENERAL

24 A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved
 25 Products Lists."

26 B. Material Compatibility:

- 27 1. Materials for use within each paint system shall be compatible with one another and substrates indicated,
 28 under conditions of service and application as demonstrated by manufacturer, based on testing and field
 29 experience.
- 30 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for
 31 use in paint system and on substrate indicated.

32 C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and
 33 coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when
 34 calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 35
- 36 1. Flat Paints and Coatings: 50 g/L.
- 37 2. Nonflat Paints and Coatings: 150 g/L.
- 38 3. Dry-Fog Coatings: 400 g/L.
- 39 4. Primers, Sealers, and Undercoaters: 200 g/L.
- 40 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
- 41 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
- 42 7. Pretreatment Wash Primers: 420 g/L.
- 43 8. Floor Coatings: 100 g/L.
- 44 9. Shellacs, Clear: 730 g/L.
- 45 10. Shellacs, Pigmented: 550 g/L.

46 D. BLOCK FILLERS

- 47
- 48 1. Block Filler, Latex, Interior/Exterior: MPI #4.

49 E. PRIMERS/SEALERS

- 1
2 1. Primer Sealer, Latex, Interior: MPI #50.
3 2. Primer, Alkali Resistant, Water Based: MPI #3.
- 4 F. METAL PRIMERS
5
6 1. Primer, Rust-Inhibitive, Water Based: MPI #107.
- 7 G. WATER-BASED PAINTS
8
9 1. Latex, Interior, Flat, (Gloss Level 1): MPI #53.
10 2. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 2): MPI #138.
11 3. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.
12 4. Light Industrial Coating, Interior, Water Based, Semi-Gloss: MPI #153.
- 13 H. FLOOR COATINGS
14
15 1. Sealer, Water Based, for Concrete Floors: MPI #99.
- 16 2.3 SOURCE QUALITY CONTROL
- 17 A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
- 18 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be
19 notified in advance and may be present when samples are taken. If paint materials have already been
20 delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and
21 certified by testing agency.
22 2. Testing agency will perform tests for compliance with product requirements.
23 3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply
24 with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for
25 testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove
26 rejected materials from previously painted surfaces if, on repainting with complying materials, the two
27 paints are incompatible.
- 28 PART 3 - EXECUTION
- 29 3.1 EXAMINATION
- 30 A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum
31 moisture content and other conditions affecting performance of the Work.
- 32 B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
- 33 1. Concrete: 12 percent.
34 2. Masonry (Clay and CMUs): 12 percent.
35 3. Gypsum Board: 12 percent.
- 36 C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- 37 D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- 38 E. Proceed with coating application only after unsatisfactory conditions have been corrected.
- 39 1. Application of coating indicates acceptance of surfaces and conditions.

- 1 3.2 PREPARATION
- 2 A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification
3 Manual" applicable to substrates and paint systems indicated.
- 4 B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If
5 removal is impractical or impossible because of size or weight of item, provide surface-applied protection before
6 surface preparation and painting.
- 7 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were
8 removed. Remove surface-applied protection if any.
- 9 C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible
10 paints and encapsulants.
- 11 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required
12 to produce paint systems indicated.
- 13 D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if
14 moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written
15 instructions.
- 16 E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of
17 surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- 18 F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in
19 writing by paint manufacturer **but not less than the following:**
20 1. SSPC-SP 3.
- 21 G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint
22 exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-
23 primed surfaces.
- 24 3.3 APPLICATION
- 25 A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- 26 1. Use applicators and techniques suited for paint and substrate indicated.
27 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final
28 installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
29 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match
30 exposed surfaces.
31 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance
32 rating, or nomenclature plates.
33 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished
34 if acceptable to topcoat manufacturers.
- 35 B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to
36 be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to
37 distinguish each separate coat.
- 38 C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint
39 finish, color, and appearance.
- 40 D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs,
41 sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- 1 E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
- 2 1. Paint the following work where exposed in occupied spaces:
- 3 a. Equipment, including panelboards.
- 4 b. Uninsulated metal piping.
- 5 c. Uninsulated plastic piping.
- 6 d. Pipe hangers and supports.
- 7 e. Metal conduit.
- 8 f. Plastic conduit.
- 9 g. Other items as directed by Architect.
- 10 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible
- 11 from occupied spaces.

12 3.4 FIELD QUALITY CONTROL

- 13 A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect
- 14 and test paint for dry film thickness.
- 15 1. Contractor shall touch up and restore painted surfaces damaged by testing.
- 16 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's
- 17 written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide
- 18 dry film thickness that complies with paint manufacturer's written recommendations.

19 3.5 CLEANING AND PROTECTION

- 20 A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 21 B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or
- 22 other methods. Do not scratch or damage adjacent finished surfaces.
- 23 C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by
- 24 cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- 25 D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

26 3.6 INTERIOR PAINTING SCHEDULE

- 27 A. Concrete Substrates, Nontraffic Surfaces:
- 28 1. High-Performance Architectural Latex System:
- 29 a. Prime Coat: Primer, alkali resistant, water based, **MPI #3**.
- 30 b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- 31 c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), **MPI #138**.
- 32 B. Concrete Substrates, Traffic Surfaces:
- 33 1. Water-Based Concrete Floor Sealer System:
- 34 a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
- 35 b. Topcoat: Sealer, water based, for concrete floors, **MPI #99**.

- 1 C. CMU Substrates:
- 2 1. High-Performance Architectural Latex System:
- 3 a. Block Filler: Block filler, latex, interior/exterior, **MPI #4.**
- 4 b. Prime Coat: Primer, alkali resistant, water based, **MPI #3.**
- 5 c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- 6 d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), **MPI #138.**
- 7 D. Steel Substrates:
- 8 1. Water-Based Light Industrial Coating System:
- 9 a. Prime Coat: Primer, rust-inhibitive, water based **MPI #107.**
- 10 b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- 11 c. Topcoat: Light industrial coating, interior, water based, semi-gloss (MPI Gloss Level 5), **MPI #153.**
- 12 E. **Gypsum Board** Substrates:
- 13 1. High-Performance Architectural Latex System:
- 14 a. Prime Coat: Primer sealer, latex, interior, **MPI #50.**
- 15 b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- 16 c. Topcoat: Latex, interior, flat (MPI Gloss Level 1), **MPI #53.**
- 17 d. Prime Coat: Primer sealer, latex, interior, **MPI #50.**
- 18 e. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- 19 f. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 2), **MPI #138.**
- 20 g. Prime Coat: Primer sealer, latex, interior, **MPI #50.**
- 21 h. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- 22 i. Topcoat: Latex, interior, high performance architectural, semi-gloss (MPI Gloss Level 5), **MPI #141.**
- 23
- 24 3.7 Color Schedule:
- 25
- 26 1. PT-1 Paint
- 27 2. Manufacturer: Sherwin Williams
- 28 3. Color: SW7029 Agreeable Gray
- 29
- 30 4. PT-2 Paint
- 31 5. Manufacturer: Sherwin Williams
- 32 6. Color: SW7045 Intellectual Gray
- 33
- 34 7. PT-3 Paint
- 35 8. Manufacturer: Sherwin Williams
- 36 9. Color: SW7046 Anonymous
- 37
- 38 10. PT-4 Paint
- 39 11. Manufacturer: Benjamin Moore
- 40 12. Color: HC-149 Buxton Blue
- 41
- 42 13. PT-5 Paint
- 43 14. Manufacturer: Benjamin Moore
- 44 15. Color: 2156-30 Jack O’lantern
- 45

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- 16. PT-6 Paint
 - 17. Manufacturer: Benjamin Moore
 - 18. Color: 2061-20 Champion Cobalt
 - 19. PT-7 Paint
 - 20. Manufacturer: Benjamin Moore
 - 21. Color: 2123-30 Sea Star
 - 22. PT-8 Paint
 - 23. Manufacturer: Benjamin Moore
 - 24. Color: 2137-70 White Wisp
 - 25. SC-1 Sealed Concrete

14 END OF SECTION 099123

1 SECTION 101100 - VISUAL DISPLAY UNITS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Visual display board assemblies.
9 2. Rail support systems for visual display board assemblies.
10 3. Modular support systems for visual display board assemblies.

11 B. Related Requirements:

- 12 1. Section 097723 "Fabric-Wrapped Panels" for fabric-covered panels mounted on walls.
13 2. Section 101200 "Display Cases" for **individually framed and enclosed, wall-mounted display cases.**

14 1.3 ACTION SUBMITTALS

15 A. Product Data: For each type of product.

- 16 1. Include construction details, material descriptions, dimensions of individual components and profiles,
17 finishes, and accessories for visual display units.
18 2. Include electrical characteristics for motorized units.

19 B. Sustainable Design Submittals:

- 20 1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content and chemical
21 components.
22 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
23 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
24 product having recycled content.
25 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
26 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
27 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
28 material, and fraction by weight that is considered regional.
29

30 C. Shop Drawings: For visual display units.

- 31 1. Include plans, elevations, sections, details, and attachment to other work.
32 2. Show locations of panel joints.[**Show locations of field-assembled joints for factory-fabricated units too**
33 **large to ship in one piece.**]
34 3. Show locations and layout of special-purpose graphics.
35 4. Include sections of typical trim members.
36 5. Include wiring diagrams for power and control wiring.

- 1 D. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color
2 finishes, and as follows:
- 3 1. Samples of facings for each visual display panel type, indicating color and texture.
4 2. Actual factory-finish color samples, applied to **aluminum** substrate.
5 3. Include accessory Samples to verify color selected.
6 4. Trim: **6-inch- (150-mm-)** long sections of each trim profile.
7 5. Accessories: Full-size Sample of each type of accessory.
- 8 E. Product Schedule: For visual display units. **Use same designations indicated on Drawings.**
- 9 1.4 INFORMATIONAL SUBMITTALS
- 10 A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for
11 surface-burning characteristics of tackboards.
- 12 B. Sample Warranties: For special warranties.
- 13 1.5 CLOSEOUT SUBMITTALS
- 14 A. Maintenance Data: For visual display units to include in maintenance manuals.
- 15 1.6 DELIVERY, STORAGE, AND HANDLING
- 16 A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum
17 manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in
18 locations indicated on approved Shop Drawings.
- 19 1.7 PROJECT CONDITIONS
- 20 A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight,
21 wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating
22 and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the
23 construction period.
- 24 B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field
25 measurements before fabrication.
- 26 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.
- 27 1.8 WARRANTY
- 28 A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face
29 sheets that fail in materials or workmanship within specified warranty period.
- 30 1. Failures include, but are not limited to, the following:
- 31 a. Surfaces lose original writing and erasing qualities.
32 b. Surfaces exhibit crazing, cracking, or flaking.
- 33 2. Warranty Period: **50** years from date of Substantial Completion.

1 PART 2 - PRODUCTS

2 2.1 MANUFACTURERS

3 A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

4 2.2 PERFORMANCE REQUIREMENTS

5 A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products
6 with appropriate markings of applicable testing agency.

- 7 1. Flame-Spread Index: **25** or less.
8 2. Smoke-Developed Index: **450** or less.

9 2.3 VISUAL DISPLAY BOARD ASSEMBLY (**CB-1**)

10 A. Subject to compliance with requirements, provide Claridge Products and Equipment, Inc. or a comparable product
11 by one of the following

- 12 1. AARCO Products, Inc.
13 2. Bangor Cork Company, Inc.
14 3. Best-Rite Manufacturing.
15 4. Claridge Products and Equipment, Inc.
16 5. Ghent Manufacturing, Inc.
17 6. Marsh Industries, Inc.; Visual Products Group.
18 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
19 8. PolyVision Corporation; a Steelcase company.
20 9. Tri-Best Visual Display Products.

21 B. Visual Display Board Assembly: **Factory** fabricated.

- 22 1. Assembly: **Chalkboard**.
23 2. Corners: **Square**.
24 3. Width: **As indicated on Drawings**.
25 4. Height: **As indicated on Drawings**.
26 5. Mounting Method: **Direct to wall**.

27 C. Chalkboard Panel: **Porcelain-enamel-faced** chalkboard panel on core indicated.

- 28 1. Color: **Black**.

29 D. Aluminum Frames: Fabricated from not less than **0.062-inch- (1.57-mm-)** thick, extruded aluminum; **standard size**
30 **and shape**.

- 31 1. Aluminum Finish: **Manufacturer's standard baked-enamel or powder-coat** finish.

- 32 a. Color: **Black**.

33 E. Chalktray: Manufacturer's standard; continuous.

35 2.4 VISUAL DISPLAY BOARD ASSEMBLY (**TB-1, TB-2, TB-3, and TB-4**)

36 A. Subject to compliance with requirements, provide products from one of the following:
37

1. AARCO Products, Inc.
 2. Bangor Cork Company, Inc.
 3. Best-Rite Manufacturing.
 4. Claridge Products and Equipment, Inc.
 5. Ghent Manufacturing, Inc.
 6. Forbo.
 7. Marsh Industries, Inc.; Visual Products Group.
 8. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 9. PolyVision Corporation; a Steelcase company.
 10. Walltalkers.
 11. Tri-Best Visual Display Products.
12. B. TB Tack Board
13. 1. TB-4
 14. 2. Manufacturer: Forbo Bulletin Board
 15. 3. Color: 2210 Hot Salsa
 16. 4. *Roll good; Edges to be framed w/ brushed aluminum channel
- 17.
 18. 1. TB-1, TB-2, TB-3
 19. 2. Manufacturer: Forbo Bulletin Board
 20. 3. Color: 2182 Potato Skin
 21. 4. *Roll good; Edges to be framed w/ brushed aluminum channel
22. C. Visual Display Board Assembly: **Factory** fabricated.
23. 1. Assembly: **Tackboard**.
 24. 2. Corners: **Square**.
 25. 3. Width: **As indicated on Drawings**.
 26. 4. Height: **As indicated on Drawings**.
 27. 5. Mounting Method: **Direct to wall**.
28. D. Tackboard Panel: Plastic-Impregnated-Cork.
29. 1. Color and Pattern: **As selected by Architect from full range of industry colors**
30. E. Aluminum Frames: Fabricated from not less than **0.062-inch- (1.57-mm-)** thick, extruded aluminum; **standard size and shap**.
31. 1. Aluminum Finish: **Clear anodic** finish.
- 32.
33. F. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum
34. number of joints, **as indicated on approved Shop Drawings**.
35. 2.5 VISUAL DISPLAY BOARD ASSEMBLY (**WB-1, WB-2, and WB-3**)
36. A. Subject to compliance with requirements, provide Claridge Products and Equipment, Inc.or a comparable product
37. by one of the following
38. 1. AARCO Products, Inc.
 39. 2. Bangor Cork Company, Inc.
 40. 3. Best-Rite Manufacturing.
 41. 4. Claridge Products and Equipment, Inc.
 42. 5. Ghent Manufacturing, Inc.
 43. 6. Marsh Industries, Inc.; Visual Products Group.
 44. 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 45. 8. PolyVision Corporation; a Steelcase company.
 46. 9. Tri-Best Visual Display Products.
47. B. Visual Display Board Assembly: **Factory** fabricated.

- 1 1. Assembly: **Markerboard.**
- 2 2. Corners: **Square.**
- 3 3. Width: **As indicated on Drawings.**
- 4 4. Height: **As indicated on Drawings.**
- 5 5. Mounting Method: **Direct to wall.**

- 6 C. Markerboard Panel: **Porcelain-enamel-faced** markerboard panel on core indicated.

- 7 1. Color: **White.**

- 8 D. Aluminum Frames: Fabricated from not less than **0.062-inch- (1.57-mm-)** thick, extruded aluminum; **standard size**
- 9 **and shape.**

- 10 1. Aluminum Finish: **Clear anodic** finish.

- 11 E. Chalktray: Manufacturer's standard; continuous.

- 12 2.6 CHALKBOARD PANELS

- 13 A. Porcelain-Enamel Chalkboard Panels: High-pressure, factory-laminated chalkboard panels of balanced three-ply
- 14 construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with matte
- 15 finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

- 16 1. Face Sheet Thickness: Minimum **[0.013 inch (0.33 mm)]** uncoated base metal thickness.
- 17 2. Particleboard Core: **3/8 inch (9.5 mm)** thick; with **0.015-inch- (0.38-mm-)** thick, **aluminum sheet** backing.
- 18 3. Medium-Density Fiberboard Core: **7/16 inch (11 mm)** thick; with manufacturer's standard moisture-barrier
- 19 backing.
- 20 4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

- 21 2.7 MARKERBOARD PANELS

- 22 A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-
- 23 ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with **low-**
- 24 **gloss** finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

- 25 1. Face Sheet Thickness: Minimum **[0.013 inch (0.33 mm)]** uncoated base metal thickness.
- 26 2. Particleboard Core: **3/8 inch (9.5 mm)** thick; with **0.015-inch- (0.38-mm-)** thick, **aluminum sheet** backing.
- 27 3. Medium-Density Fiberboard Core: **7/16 inch (11 mm)** thick; with manufacturer's standard moisture-barrier
- 28 backing.
- 29 4. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

- 30 2.8 TACKBOARD PANELS

- 31 A. Tackboard Panels:

- 32 1. Facing: **1/4-inch- (6-mm-)** thick **plastic-impregnated cork.**
- 33 2. Core: Manufacturer's standard.

- 34 2.9 MATERIALS

- 35 A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

- 1 B. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed
2 oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish
3 and integral color throughout **with surface-burning characteristics indicated.**
- 4 C. Particleboard: ANSI A208.1, Grade M-1.
- 5 D. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
- 6 E. Extruded Aluminum: **ASTM B 221 (ASTM B 221M)**, Alloy 6063.
- 7 F. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets,
8 or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- 9 G. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements in **Section 099123 "Interior Painting"**
10 and recommended in writing by visual display unit manufacturer for intended substrate.

11 2.10 GENERAL FINISH REQUIREMENTS

- 12 A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for
13 applying and designating finishes.
- 14 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
15 covering before shipping.
- 16 C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of
17 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
18 installed to minimize contrast.

19 2.11 ALUMINUM FINISHES

- 20 A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- 21 B. Baked-Enamel or Powder-Coat Finish: AAMA 2603, except with a minimum dry film thickness of **1.5 mils (0.04 mm)**.
22 Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking
23 finish.

24 PART 3 - EXECUTION

25 3.1 EXAMINATION

- 26 A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation
27 tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- 28 B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of
29 motorized, sliding visual display units.
- 30 C. Examine walls and partitions for proper preparation and backing for visual display units.
- 31 D. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- 32 E. Proceed with installation only after unsatisfactory conditions have been corrected.

- 1 3.2 PREPARATION
- 2 A. Comply with manufacturer's written instructions for surface preparation.
- 3 B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the
4 smooth, finished surfaces of visual display boards.
- 5 C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects,
6 projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- 7 D. Prime wall surfaces indicated to receive **visual display units** and as recommended in writing by primer/sealer
8 manufacturer and visual display unit manufacturer.
- 9 E. Prepare recesses for sliding visual display units as required by type and size of unit.
- 10 3.3 INSTALLATION
- 11 A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not
12 indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips,
13 backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- 14 B. Field-Assembled Visual Display Board Assemblies: Coordinate field-assembled units with grounds, trim, and
15 accessories indicated. Join parts with a neat, precision fit.
- 16 1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum
17 number of joints, **as indicated on approved Shop Drawings**.
- 18 C. Factory-Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with **egg-size** adhesive gobs at **16**
19 **inches (400 mm)** o.c., horizontally and vertically.
- 20 D. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces
21 and to visual display board assemblies with fasteners at not more than **16 inches (400 mm)** o.c. Secure tops and
22 bottoms of boards to walls.
- 23 3.4 CLEANING AND PROTECTION
- 24 A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning
25 instructions label to visual display unit in each room.
- 26 B. Touch up factory-applied finishes to restore damaged or soiled areas.
- 27 C. Cover and protect visual display units after installation and cleaning.
- 28 END OF SECTION 101100

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1 SECTION 101200 - DISPLAY CASES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Bulletin boards.

- 9 B. Related Requirements:

- 10 1. Section 101100 "Visual Display Units" for tackboards.

11 1.3 DEFINITIONS

- 12 A. Bulletin Board: Glazed cabinet with tackboard panel, without shelves, typically of shallow depth for display of paper
13 documents.

- 14 B. Tackboard Panel: A material for holding push-pins or tacks typically consisting of a facing; such as fabric, vinyl, or
15 cork; adhered to a substrate; such as fiberboard, hardboard, particleboard.

16 1.4 ACTION SUBMITTALS

- 17 A. Product Data: For each type of product.

- 18 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
19 finishes for **bulletin boards**. Include furnished specialties and accessories.
20 2. Include electrical characteristics for illuminated **bulletin boards**.

- 21 B. Sustainable Design Submittals:

- 22
23 1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content and chemical
24 components.
25 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
26 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
27 product having recycled content.
28 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
29 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
30 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
31 material, and fraction by weight that is considered regional.

- 32 C. Shop Drawings: For **bulletin boards**.

- 33 1. Include plans, elevations, sections, and attachment details.

- 1 2. Show location of seams and joints in tackboard panels.
2 3. Include sections of typical trim members.
- 3 D. Samples: For each exposed product and for each color and texture specified; not less than 8-1/2 by 11 inches (215
4 by 280 mm) for tackboard panels and 6 inches (150 mm) long for trim with factory finish.
- 5 E. Samples for Initial Selection: For each type of exposed finish.
- 6 1. Include Samples of tackboard panels and factory-finished trim involving color finish selection.
- 7 1.5 INFORMATIONAL SUBMITTALS
- 8 A. Product Test Reports: For **tackboard panels**, for tests performed by a qualified testing agency.
- 9 1.6 CLOSEOUT SUBMITTALS
- 10 A. Maintenance Data: For **bulletin boards** to include in maintenance manuals.
- 11 1.7 PROJECT CONDITIONS
- 12 A. Environmental Limitations: Do not deliver or install **bulletin board** for indoor installations until spaces are enclosed
13 and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC
14 system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the
15 remainder of the construction period.
- 16 PART 2 - PRODUCTS
- 17 2.1 MANUFACTURERS
- 18 A. Subject to compliance with requirements, provide Claridge Products and Equipment, Inc. or a comparable product
19 by one of the following
20 1. AARCO Products, Inc.
21 2. Bangor Cork Company, Inc.
22 3. Best-Rite Manufacturing.
23 4. Claridge Products and Equipment, Inc.
24 5. Ghent Manufacturing, Inc.
25 6. Marsh Industries, Inc.; Visual Products Group.
26 7. Platinum Visual Systems; a division of ABC School Equipment, Inc.
27 8. PolyVision Corporation; a Steelcase company.
28 9. Tri-Best Visual Display Products.
- 29 2.2 PERFORMANCE REQUIREMENTS
- 30 A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products
31 with appropriate markings of applicable testing agency.
- 32 1. Flame-Spread Index: **25** or less.
33 2. Smoke-Developed Index: **450** or less.

- 1 2.3 BULLETIN BOARD
- 2 A. General: Factory-fabricated unit consisting of manufacturer's standard wall-mounted cabinet with tackboard panel
3 on back inside surface and operable glazed doors at front.
- 4 1. Frame and Cabinet Profile: **Square** frame section with **square** cabinet corners.
5 2. Mounting: **Surface mounted**.
6 3. Size: **36 inches** wide by **36 inches** high by **4 inches (102 mm)** deep.
- 7 B. Aluminum-Framed Cabinet: Extruded aluminum; with **clear anodic** finish.
- 8 C. Glazed Hinged Doors: **Tempered glass**; unframed; with extruded-aluminum top and bottom track; supported on
9 nylon or ball-bearing rollers; with plastic top guide and rubber bumpers. Equip each door with ground finger pull
10 and adjustable cylinder lock with two keys.
- 11 1. Thickness: Not less than **5 mm** thick.
12 2. Number of Doors: **One**.
- 13 D. Back Panel: Plastic-impregnated-cork tackboard panel to match TB-1 and TB-2.
- 14 1. Color: **As selected by Architect from full range of industry colors**.
- 15 2.4 TACKBOARD PANELS
- 16 A. Plastic-Impregnated-Cork Tackboard Panel: **1/4-inch- (6-mm-)** thick, plastic-impregnated-cork sheet factory
17 laminated to **1/4-inch- (6-mm-)** thick **hardboard or particleboard** backing.
- 18 2.5 MATERIALS
- 19 A. Hardboard: ANSI A135.4, tempered.
- 20 B. Particleboard: ANSI A208.1, Grade M-1.
- 21 C. Plastic-Impregnated-Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed
22 oil, resin binders, and dry pigments that are mixed and calendared onto burlap backing; with washable vinyl finish
23 and integral color throughout.
- 24 D. Extruded-Aluminum Bars and Shapes: **ASTM B 221 (ASTM B 221M)**, Alloy 6063.
- 25 E. Aluminum Tubing: ASTM B 429/B 429M, Alloy 6063.
- 26 F. Clear Tempered Glass: ASTM C 1048, Kind FT, Condition A, Type I, Class 1, Quality Q3, with exposed edges seamed
27 before tempering.
- 28 G. Fasteners: Provide screws, bolts, and other fastening devices made from same material as items being fastened,
29 except provide hot-dip galvanized, stainless-steel, or aluminum fasteners for exterior applications. Provide types,
30 sizes, and lengths to suit installation conditions. Use security fasteners where exposed to view.
- 31 2.6 FABRICATION
- 32 A. Fabricate **bulletin boards** to requirements indicated for dimensions, design, and thickness and finish of materials.

1 B. Use metals and shapes of thickness and reinforcing required to produce flat surfaces, and to impart strength for
2 size, design, and application indicated.

3 C. Fabricate cabinets and door frames with reinforced corners, mitered to a hairline fit, with no exposed fasteners.

4 D. Fabricate shelf standards plumb and at heights to align shelf brackets for level shelves.

5 2.7 GENERAL FINISH REQUIREMENTS

6 A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for
7 applying and designating finishes.

8 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
9 covering before shipping.

10 C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of
11 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
12 installed to minimize contrast.

13 2.8 ALUMINUM FINISHES

14 A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

15 PART 3 - EXECUTION

16 3.1 EXAMINATION

17 A. Examine walls, with Installer present, for compliance with requirements for installation tolerances, surface
18 conditions of wall, and other conditions affecting performance of the Work.

19 B. Examine roughing-in for electrical power systems to verify actual locations of connections before installation of
20 illuminated units.

21 C. Examine walls and partitions for proper backing for **bulletin boards**.

22 D. Examine walls and partitions for suitable framing depth if recessed units will be installed.

23 E. Proceed with installation only after unsatisfactory conditions have been corrected.

24 3.2 INSTALLATION

25 A. General: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at heights
26 indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials,
27 adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

28 1. Mounting Height: **72 inches (1829 mm)** above finished floor to top of cabinet unless noted otherwise on
29 drawings.

30 B. Bulletin Boards: Attach units to wall surfaces with concealed clips, hangers, or grounds.

- 1 3.3 ADJUSTING AND CLEANING
- 2 A. Adjust doors to operate smoothly without warp or bind and so contact points meet accurately. Lubricate operating
- 3 hardware as recommended by manufacturer.
- 4 B. Touch up factory-applied finishes to restore damaged areas.
- 5 END OF SECTION 101200

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1 SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Cast dimensional characters.
9 2. Cutout dimensional characters.
10 3. Fabricated channel dimensional characters.

11 1.3 ACTION SUBMITTALS

- 12 A. Product Data: For each type of product.

- 13 B. Sustainable Design Submittals:

- 14
15 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
16 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
17 product having recycled content.
18 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
19 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
20 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
21 material, and fraction by weight that is considered regional.
22 3. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.

- 23 C. Shop Drawings: For signs.

- 24 1. Include fabrication and installation details and attachments to other work.
25 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and
26 accessories.
27 3. Show message list, timesteps, graphic elements, and layout for each sign at least half size.

- 28 D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in
29 manufacturer's standard size unless otherwise indicated and as follows:

- 30 1. Dimensional Characters: Full-size Sample of dimensional character.
31 2. Exposed Accessories: Full-size Sample of each accessory type.

- 32 E. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

33 1.4 INFORMATIONAL SUBMITTALS

- 34 A. Qualification Data: For manufacturer.

- 1 B. Sample Warranty: For special warranty.
- 2 1.5 CLOSEOUT SUBMITTALS
- 3 A. Maintenance Data: For signs to include in maintenance manuals.
- 4 1.6 WARRANTY
- 5 A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or
6 workmanship within specified warranty period.
- 7 1. Failures include, but are not limited to, the following:
- 8 a. Deterioration of finishes beyond normal weathering.
- 9 b. Separation or delamination of sheet materials and components.
- 10 2. Warranty Period: Five years from date of Substantial Completion.

11 PART 2 - PRODUCTS

12 2.1 PERFORMANCE REQUIREMENTS

- 13 A. Thermal Movements: For exterior characters, allow for thermal movements from ambient and surface temperature
14 changes.
- 15 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

16 2.2 DIMENSIONAL CHARACTERS

- 17 A. Metal face formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and
18 profiles; to meet performance loading without oil-canning or other surface deformation, and for securing fasteners;
19 and as follows.
- 20 1. Character Material: Sheet or plate aluminum.
- 21 2. Material Thickness: 0.500 inches.
- 22 3. Character Height: As indicated on Drawings.
- 23 4. Finishes:
- 24
- 25 a. Integral Aluminum Finish: Black anodized.
- 26 5. Mounting: Mounting: Concealed studs.
- 27 a. Hold characters at 1-inch distance from wall surface.
- 28 6. Typeface: Times Roman.

29 2.3 DIMENSIONAL CHARACTER MATERIALS

- 30 A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer
31 and finisher for type of use and finish indicated.

1 B. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by aluminum producer and
2 finisher for type of use and finish indicated.

3 2.4 ACCESSORIES

4 A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and
5 compatible with each material joined, and complying with the following:

- 6 1. Use concealed fasteners and anchors unless indicated to be exposed.
- 7 2. For exterior exposure, furnish nonferrous-metal or stainless-steel devices unless otherwise indicated.
- 8 3. Exposed Metal-Fastener Components, General:

9 a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

10 4. Sign Mounting Fasteners:

11 a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material,
12 screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign
13 material, unless otherwise indicated.

14 B. Adhesive: As recommended by sign manufacturer.

15 C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

16 2.5 FABRICATION

17 A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

- 18 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies
19 only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation;
20 apply markings in locations concealed from view after final assembly.
- 21 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration
22 and retention.
- 23 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind
24 finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed
25 connections of flux, and dress exposed and contact surfaces.
- 26 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
- 27 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-
28 canning or other surface deformation, and for securing fasteners.
- 29 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and
30 tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign
31 finish.
- 32 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that
33 impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate
34 marks, casting flash, and other casting marks before finishing.

35 2.6 GENERAL FINISH REQUIREMENTS

36 A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
37 covering before shipping.

38 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
39 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
40 installed to minimize contrast.

1 C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished
2 trim or border surface unless otherwise indicated.

3 D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying
4 contrasting polished finishes on raised features unless otherwise indicated.

5 2.7 ALUMINUM FINISHES

6 A. Color Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

7 PART 3 - EXECUTION

8 3.1 EXAMINATION

9 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
10 tolerances and other conditions affecting performance.

11 B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities
12 between backs of signs and support surfaces unless otherwise indicated.

13 C. Proceed with installation only after unsatisfactory conditions have been corrected.

14 3.2 INSTALLATION

15 A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

16 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of
17 distortion and other defects in appearance.

18 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair
19 installation.

20 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete,
21 masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

22 B. Mounting Methods:

23 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose
24 debris from hole and substrate surface.

25 a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive.
26 Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support
27 sign in position until adhesive fully sets.

28 b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs
29 projecting through opposite side of surface, and tighten.

30 3.3 ADJUSTING AND CLEANING

31 A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements.
32 Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by
33 finish touchup or similar minor repair procedures.

34 B. Remove temporary protective coverings and strippable films as signs are installed.

1 C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and
2 touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect
3 from damage until acceptance by Owner.

4 END OF SECTION 101419

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SECTION 101423 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Handicapped signs
 - 2. Toilet room signs
 - 3. Life Safety Signage

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals
 - 1. Product Data for Credit MR 4 and 5:
 - a. For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - b. Include statement indicating costs for each product having recycled content.
 - 2. Product Data indicating location of material manufacturer for regionally manufactured materials.
 - a. Include statement indicating cost for each regionally manufactured material and for each regionally extracted and manufactured material.
 - 3. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statements of VOC content and chemical components.
- C. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

1 D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in
2 manufacturer's standard size unless otherwise indicated and as follows:

- 3 1. Room-Identification Signs: Full-size Sample.
- 4 2. Exposed Accessories: Full-size sample of each accessory type.

5 E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

6 1.6 INFORMATIONAL SUBMITTALS

7 A. Qualification Data: For manufacturer.

8 B. Sample Warranty: For special warranty.

9 1.7 CLOSEOUT SUBMITTALS

10 A. Maintenance Data: For signs to include in maintenance manuals.

11 1.8 FIELD CONDITIONS

12 A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers
13 by field measurements before fabrication, and indicate measurements on Shop Drawings.

14 1.9 WARRANTY

15 A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or
16 workmanship within specified warranty period.

17 1. Failures include, but are not limited to, the following:

- 18 a. Deterioration of finishes beyond normal weathering.
- 19 b. Separation or delamination of sheet materials and components.

20 2. Warranty Period: Five years from date of Substantial Completion.

21 PART 2 - PRODUCTS

22 2.1 PERFORMANCE REQUIREMENTS

23 A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers
24 Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

25 2.2 ROOM IDENTIFICATION SIGNS

26 A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable
27 product by one of the following:

- 28 1. ASI Sign Systems, Inc.
- 29 2. Ace Sign Systems, Inc.

- 1 3. Advance Corporation; Braille-Tac Division.
- 2 4. Allen Industries, Inc.
- 3 5. Allen Markings International.
- 4 6. APCO Graphics, Inc.
- 5 7. ASE, Inc.
- 6 8. ASI Sign Systems, Inc.
- 7 9. Best Sign Systems Inc.
- 8 10. Bunting Graphics, Inc.
- 9 11. Clarke Systems.
- 10 12. Diskey Sign Company.
- 11 13. Fossil Industries, Inc.
- 12 14. InPro Corporation.
- 13 15. Mohawk Sign Systems.
- 14 16. Nelson-Harkins Industries.
- 15 17. Poblocki Sign Company, LLC.
- 16 18. Seton Identification Products.
- 17 19. Supersine Company (The); Division of Stamp-Rite, Inc.
- 18 20. Vista System.
- 19 21. Vomar Products, Inc.

20 B. Signs with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and
 21 precisely formed lines and profiles; and as follows:

- 22 1. Basis-of-Design Product: InPro SignScapes
- 23 2. Profile: Modular Thin.
- 24 3. Mounting: Manufacturer's standard method for substrates indicated.
- 25 4. Text and Typeface: Accessible raised characters in typeface as selected by Architect from manufacturer's full
 26 range and Braille. Finish raised characters and Braille to contrast with background color.
- 27 5. Colors: Selected by Architect from manufacturer's full range
- 28
- 29
- 30 6. Sign Schedule:
 - 31 a. ID-1: Elevator Prohibition I.D. – (1) one at each elevator landing.
 - 32 b. ID-2: Evacuation sign – (1) digital print sign applied to back of acrylic at each elevator landing.
 33 Architect will provide electronic copy of floor plan to signage Vendor for purposes of creating evacuation
 34 plan.
 - 35 c. ID-3: Unisex Handicap accessible toilet – (2) required. Pictogram, International Symbol of
 36 Accessibility and the word Unisex with Braille subscript in compliance with ANSI 117.1
 - 37 d. ID-4: Female Handicap accessible toilet room– (1) required. Pictogram, International Symbol of
 38 Accessibility and female pictogram with Braille subscript in compliance with ANSI 117.1
 - 39 e. ID-5: Male Handicap accessible toilet room– (1) required. Pictogram, International Symbol of
 40 Accessibility and male pictogram with Braille subscript in compliance with ANSI 117.1
 - 41 f. ID-6: Stair and exit signs: Tactile exit sign in compliance with ANSI 117.1 and IBC 1011.3
 42 Text :” Stair 1” and pictogram and Braille
 43 Adjacent to each door to exit stairway on each floor on the corridor side
 44 Provide floor level sign adjacent to each door from exit stairway to corridor at each floor.
 45 Text :” Stair 2” and pictogram and Braille
 46 Adjacent to each door to exit stairway on each floor on the corridor side
 47 Provide Floor Level Sign adjacent to each door from exit stairway to corridor at each floor.
 - 48 g. ID-7: Female Locker Room sign: (1) “Locker Room” and braille, Female pictogram, pictogram
 49 International Symbol of Accessibility and with Braille subscript in compliance with ANSI 117.1
 - 50 h. ID-8: Male Locker Room sign: (1) “Locker Room” and braille, Male pictogram, pictogram
 51 International Symbol of Accessibility and with Braille subscript in compliance with ANSI 117.1
 - 52 i. ID-9: Maximum Occupancy Signage: (1) “Maximum Occupancy (-) Persons with braille subscript in
 53 compliance with ANSI 117.1

- 1 2.3 PANEL-SIGN MATERIALS
- 2 A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of
3 use and finish indicated.
- 4 B. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- 5 C. Polycarbonate Sheet: ASTM C 1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with
6 coating on both sides.
- 7 D. Fiberglass Sheet: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast,
8 nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- 9 E. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.
- 10 F. Plastic-Laminate Sheet: NEMA LD 3, general-purpose HGS grade, 0.048-inch nominal thickness.
- 11 G. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum
12 adherence to surface and are UV and water resistant for colors and exposure indicated.
- 13 2.4 ACCESSORIES
- 14 A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and
15 compatible with each material joined, and complying with the following:
- 16 1. Use concealed fasteners and anchors unless indicated to be exposed.
- 17 2. Exposed Metal-Fastener Components, General:
- 18 a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
- 19 b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts
20 with tamper-resistant Allen-head slots unless otherwise indicated.
- 21 3. Sign Mounting Fasteners:
- 22 a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or
23 screwed into back of sign assembly, unless otherwise indicated.
- 24 B. Adhesives: As recommended by sign manufacturer and that comply with the testing and product requirements of
25 the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from
26 Various Sources Using Small-Scale Environmental Chambers."
- 27 C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.
- 28 2.5 FABRICATION
- 29 A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
- 30 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies
31 only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation;
32 apply markings in locations concealed from view after final assembly.
- 33 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration
34 and retention.
- 35 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind
36 finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed
37 connections of flux, and dress exposed and contact surfaces.

- 1 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
- 2 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill
- 3 and tap for required fasteners. Use concealed fasteners.

4 2.6 GENERAL FINISH REQUIREMENTS

- 5 A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
- 6 covering before shipping.
- 7 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
- 8 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
- 9 installed to minimize contrast.
- 10 C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished
- 11 trim or border surface unless otherwise indicated.
- 12 D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying
- 13 contrasting polished finishes on raised features unless otherwise indicated.

14 2.7 ALUMINUM FINISHES

- 15 A. Clear Anodic Finish: AAMA 611.
- 16 B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply
- 17 with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

18 PART 3 - EXECUTION

19 3.1 EXAMINATION

- 20 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
- 21 tolerances and other conditions affecting performance of signage work.
- 22 B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities
- 23 between backs of signs and support surfaces unless otherwise indicated.
- 24 C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- 25 D. Proceed with installation only after unsatisfactory conditions have been corrected.

26 3.2 INSTALLATION

- 27 A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
- 28 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of
- 29 distortion and other defects in appearance.
- 30 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
- 31 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair
- 32 installation.
- 33 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete,
- 34 masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

- 1 B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls according to accessibility
2 standard.
- 3 C. Mounting Methods:
- 4 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose
5 debris from hole and substrate surface.
- 6 a. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs
7 projecting through opposite side of surface, and tighten.
- 8 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in
9 sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
- 10 3. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports
11 in position so that signage is correctly located and aligned.
- 12 4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear
13 beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign
14 after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied
15 and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive.
16 Temporarily support sign in position until adhesive fully sets.
- 17 5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape
18 strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage.
19 Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage
20 tape adhesive.

21 3.3 ADJUSTING AND CLEANING

- 22 A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace
23 signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup
24 or similar minor repair procedures.
- 25 B. Remove temporary protective coverings and strippable films as signs are installed.
- 26 C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and
27 touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect
28 from damage until acceptance by Owner.

29 END OF SECTION 101423

1 SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Solid-plastic toilet compartments configured as **toilet enclosures and urinal screens**.

9 B. Related Requirements:

- 10
11 1. **Section 061000 "Rough Carpentry"** for **blocking**.
12 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves,
13 and similar accessories mounted on toilet compartments.

14 1.3 ACTION SUBMITTALS

15 A. Product Data: For each type of product.

- 16 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
17 finishes for toilet compartments.

18 B. Sustainable Design Submittals:

- 19
20 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
21 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
22 product having recycled content.
23 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
24 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
25 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
26 material, and fraction by weight that is considered regional.

27 C. Shop Drawings: For toilet compartments.

- 28 1. Include plans, elevations, sections, details, and attachment details.
29 2. Show locations of cutouts for compartment-mounted toilet accessories.
30 3. Show locations of centerlines of toilet fixtures.
31 4. Show locations of floor drains.
32 5. Show **ceiling grid, ceiling-mounted items, and** overhead support or bracing locations.

33 D. Samples for Initial Selection: For each type of toilet compartment material indicated.

- 34 1. Include Samples of hardware and accessories involving material and color selection.

1 1.4 INFORMATIONAL SUBMITTALS

2 A. Product Certificates: For each type of toilet compartment.

3 1.5 CLOSEOUT SUBMITTALS

4 A. Maintenance Data: For toilet compartments to include in maintenance manuals.

5 1.6 PROJECT CONDITIONS

6 A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction
7 contiguous with toilet compartments by field measurements before fabrication.

8 PART 2 - PRODUCTS

9 2.1 PERFORMANCE REQUIREMENTS

10 A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products
11 with appropriate markings of applicable testing agency.

- 12 1. Flame-Spread Index: **25** or less.
13 2. Smoke-Developed Index: 450 or less.

14 B. Recycled Content of Toilet Partition Products: Postconsumer recycled content plus one-half of preconsumer
15 recycled content not less than 60 percent.

16 C. Regulatory Requirements: Comply with applicable provisions in **the U.S. Architectural & Transportation Barriers
17 Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1** for toilet
18 compartments designated as accessible.

19 2.2 SOLID-PLASTIC TOILET COMPARTMENTS

20 A. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into
21 the Work include, but are not limited to, the following:

- 22
23 1. Accurate Partitions Corporation.
24 2. American Sanitary Partition Corporation.
25 3. Ampco, Inc.
26 4. Bobrick Washroom Equipment, Inc.
27 5. Bradley Corporation; Mills Partitions.
28 6. Flush Metal Partition Corp.
29 7. General Partitions Mfg. Corp.
30 8. Global Steel Products Corp.
31 9. Knickerbocker Partition Corporation.
32 10. Metpar Corp.
33 11. Partition Systems Incorporated of South Carolina.
34 12. Rockville Partitions Incorporated.
35 13. Sanymetal; a Crane Plumbing company.
36 14. Scranton Products.
37 15. Tex-Lam Manufacturing, Inc.
38 16. Weis-Robart Partitions, Inc.

- 1 B. Toilet-Enclosure Style: **Floor anchored, overhead braced.**
- 2 C. Urinal-Screen Style: **Wall hung.**
- 3 D. Door, Panel, **Screen**, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than
4 **1 inch (25 mm)** thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of
5 material.
- 6 1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
- 7 2. Heat-Sink Strip: Manufacturer's standard continuous, **stainless-steel** strip fastened to exposed bottom
8 edges of solid-plastic components to hinder malicious combustion.
- 9 3. Color and Pattern:
- 10 TP-1
- 11 Manufacturer: Hiny Hiders
- 12 Color: Storm
- 13 Finish: Orange Peel
- 14
- 15 E. Pilaster **Shoes and Sleeves (Caps)**: Manufacturer's standard design; **stainless steel.**
- 16 F. Brackets (Fittings):
- 17
- 18 1. Full-Height (Continuous) Type: Manufacturer's standard design; **stainless steel.**
- 19 2.3 HARDWARE AND ACCESSORIES
- 20 A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
- 21 1. Hinges: Manufacturer's minimum **0.062-inch- (1.59-mm-)** thick stainless-steel, allowing emergency access
22 by lifting door. Mount with through-bolts.
- 23 2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to
24 resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision
25 for emergency access. Provide units that comply with regulatory requirements for accessibility at
26 compartments designated as accessible. Mount with through-bolts.
- 27 3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper,
28 sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-
29 bolts.
- 30 4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors.
31 Mount with through-bolts.
- 32 5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with
33 regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated
34 as accessible. Mount with through-bolts.
- 35 B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in
36 manufacturer's standard finish.
- 37 C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the
38 items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For
39 concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel
40 compatible with related materials.
- 41 2.4 MATERIALS
- 42 A. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

1 B. Stainless-Steel Castings: ASTM A 743/A 743M.

2 2.5 FABRICATION

3 A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and
4 provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

5 B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and
6 anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

7 C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling
8 adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

9 D. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard
10 toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide,
11 clear opening for compartments designated as accessible.

12 PART 3 - EXECUTION

13 3.1 EXAMINATION

14 A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support,
15 alignment, operating clearances, and other conditions affecting performance of the Work.

16 1. Confirm location and adequacy of blocking and supports required for installation.

17 B. Proceed with installation only after unsatisfactory conditions have been corrected.

18 3.2 INSTALLATION

19 A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb.
20 Secure units in position with manufacturer's recommended anchoring devices.

21 1. Maximum Clearances:

22 a. Pilasters and Panels: 1/2 inch (13 mm).

23 b. Panels and Walls: 1 inch (25 mm).

24 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

25 a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.

26 b. Align brackets at pilasters with brackets at walls.

27 B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors
28 penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's
29 written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to
30 align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are
31 in closed position.

32 C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor
33 unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors
34 and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

1 D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and
2 secured to resist lateral impact.

3 3.3 ADJUSTING

4 A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions
5 for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed
6 position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

7 END OF SECTION 102113.19

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1 SECTION 102600 - WALL PROTECTION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Wall guards.
9 2. Corner guards.

10 B. Related Requirements:

- 11
12 1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for
13 armor, kick, mop, and push plates.

14 1.3 ACTION SUBMITTALS

15 A. Product Data: For each type of product.

- 16 1. Include construction details, material descriptions, impact strength, dimensions of individual components
17 and profiles, and finishes.

18 B. LEED Submittals:

- 19
20 1. Product Data for Credit MR 4 and 5:
21 a. For products having recycled content, documentation indicating percentages by weight of
22 postconsumer and preconsumer recycled content.
23 b. Include statement indicating costs for each product having recycled content.
24 2. Product Data indicating location of material manufacturer for regionally manufactured materials.
25 a. Include statement indicating cost for each regionally manufactured material and for each regionally
26 extracted and manufactured material.
27 3. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statements of VOC content
28 and chemical components.

29 C. Shop Drawings: For each type of wall and door protection showing locations and extent.

- 30 1. Include plans, elevations, sections, and attachment details.

31 D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size
32 indicated below:

- 33 1. Wall Guards: 12 inches (300 mm) long. Include examples of joinery, corners, end caps, top caps, and field
34 splices.
35 2. Corner Guards: 12 inches (300 mm) long. Include example top caps.

- 1 1.4 INFORMATIONAL SUBMITTALS
- 2 A. Material Certificates: For each type of exposed plastic material.
- 3 B. Sample Warranty: For special warranty.
- 4 1.5 CLOSEOUT SUBMITTALS
- 5 A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
- 6 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic
- 7 covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and
- 8 methods that may be detrimental to finishes and performance.
- 9 1.6 DELIVERY, STORAGE, AND HANDLING
- 10 A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected
- 11 from weather, moisture, soiling, extreme temperatures, and humidity.
- 12 1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period
- 13 plastic materials are stored.
- 14 2. Keep plastic materials out of direct sunlight.
- 15 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material
- 16 attains a minimum room temperature of 70 deg F (21 deg C).
- 17 a. Store corner-guard covers in a vertical position.
- 18 b. Store wall-guard covers in a horizontal position.
- 19 1.7 WARRANTY
- 20 A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail
- 21 in materials or workmanship within specified warranty period.
- 22 1. Failures include, but are not limited to, the following:
- 23 a. Structural failures including detachment of components from each other or from the substrates,
- 24 delamination, and permanent deformation beyond normal use.
- 25 b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
- 26 2. Warranty Period: Five years from date of Substantial Completion.
- 27 PART 2 - PRODUCTS
- 28 2.1 MANUFACTURERS
- 29 A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

- 1 2.2 PERFORMANCE REQUIREMENTS
- 2 A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify
- 3 products with appropriate markings of applicable testing agency.
- 4 1. Flame-Spread Index: 25 or less.
- 5 2. Smoke-Developed Index: 450 or less.
- 6 2.3 CORNER GUARDS
- 7 A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on,
- 8 resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn
- 9 to match wall condition.
- 10 1. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:
- 11 a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
- 12 b. Height: 4 feet (1.2 m).
- 13 c. Color and Texture: As selected by Architect from manufacturer's full range.
- 14 2. Continuous Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
- 15 3. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for
- 16 close alignment with snap-on cover.
- 17 B. CG Corner Guard
- 18 1. CG-1
- 19 2. Manufacturer: Inpro
- 20 3. Type: Surface Mount - G2 Bioblend Retainer
- 21 4. Style: 160 – 90 degree
- 22 5. Color: Eggshell 0111
- 23
- 24 1. CG-2 Corner Guard
- 25 2. Manufacturer: Inpro
- 26 3. Type: Surface Mount - G2 Bioblend Retainer
- 27 4. Style: 160 – 90 degree
- 28 5. Color: Pepperdust 0119
- 29
- 30 1. CG-3 Corner Guard
- 31 2. Manufacturer: Inpro
- 32 3. Type: Surface Mount - G2 Bioblend Retainer
- 33 4. Style: 160 – 90 degree
- 34 5. Color: Point Blue 0165
- 35 2.4 WALL GUARDS
- 36 A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.
- 37 1. Size: 48 by 96 inches (1219 by 2438 mm) for sheet.
- 38 2. Sheet Thickness: 0.040 inch (1.0 mm).
- 39 3. Color and Texture: As selected by Architect from manufacturer's full range.
- 40 4. Height: See below and drawings
- 41 5. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
- 42 6. Mounting: Adhesive.
- 43 B.
- 44 1. WP-2 Wall Protection

- 1 2. Manufacturer: Inpro
- 2 3. Style: Rigid Sheet
- 3 4. Color: Eggshell 0111
- 4 5. 1'-6" H strips adhered directly to wall; mounting height 30" AFF, unless noted otherwise

- 5
- 6 1. WP-3 Wall Protection
- 7 2. Manufacturer: Inpro
- 8 3. Style: Rigid Sheet
- 9 4. Color: Point Blue 0165
- 10 5. 1'-6" H strips adhered directly to wall; mounting height 30" AFF

- 11
- 12 1. WP-4 Wall Protection
- 13 2. Manufacturer: Inpro
- 14 3. Style: Rigid Sheet
- 15 4. Color: Pepperdust 0119
- 16 5. 1'-6" H strips adhered directly to wall; mounting height 30" AFF

17 2.5 MATERIALS

- 18 A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- 19
- 20 B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. (800 J/m) of notch when tested according to ASTM D 256, Test Method A.
- 21
- 22 C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- 23

24 2.6 FABRICATION

- 25 A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- 26
- 27 B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- 28
- 29 C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
- 30
- 31

32 2.7 FINISHES

- 33 A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 34
- 35 B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- 36
- 37

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

- 3 A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation
4 tolerances and other conditions affecting performance of the Work.
- 5 B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have
6 been installed in the locations required for secure attachment of support fasteners.
- 7 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates,
8 including compatibility with existing finishes or primers.
- 9 C. Proceed with installation only after unsatisfactory conditions have been corrected.

10 3.2 PREPARATION

- 11 A. Complete finishing operations, including painting, before installing wall and door protection.
- 12 B. Before installation, clean substrate to remove dust, debris, and loose particles.

13 3.3 INSTALLATION

- 14 A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb,
15 and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that
16 might be visible in the finished Work.
- 17 B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a
18 complete installation.
- 19 1. Provide anchoring devices and suitable locations to withstand imposed loads.
20 2. Where splices occur in horizontal runs of more than 20 feet (6.1 m), splice aluminum retainers and plastic
21 covers at different locations along the run, but no closer than 12 inches (305 mm) apart.
22 3. Adjust end and top caps as required to ensure tight seams.
- 23 C. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete
24 installation.

25 3.4 CLEANING

- 26 A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based
27 household cleaning agent.
- 28 B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

29 END OF SECTION 102600

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1 SECTION 102641 - BULLET RESISTANT FIBERGLASS PANELS

2

3 PART 1 GENERAL

4 1.1 RELATED DOCUMENTS

- 5 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
6 Specification Sections, apply to this Section.

7 1.2 SUMMARY

- 8 A. Section Includes:

- 9 1. Bullet resistant fiberglass panels.

10 1.3 REFERENCE

- 11 A. UNDERWRITERS LABORATORY UL 752

- 12 B. Standard for Bullet Resisting Equipment

13 1.4 ACTION SUBMITTALS

- 14 A. Product Data: For each type of product.

- 15 B. Sustainable Design Submittals:

16

- 17 1. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
18 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
19 product having recycled content.

- 20 2. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
21 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
22 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
23 material, and fraction by weight that is considered regional.

- 24 3. Product Data for Credit EQ 4.1: For adhesives, documentation including printed statement of VOC content.

- 25 C. Catalog cuts, brochures, specifications, UL LISTING VERIFICATION, proof of possession of PRODUCT LIABILITY
26 INSURANCE in an amount not less than five million U.S. dollars.

- 27 D. Manufacturer's instructions for the installation of Bullet Resistant Fiberglass.

28 1.5 DELIVERY, STORAGE AND HANDLING

- 29 A. Deliver the materials to the project with the manufacturer's UL Labels intact and legible. Handle the material with
30 care to prevent damage. Store the materials inside under cover, stack flat and off the floor.

- 31 1.6 WARRANTY
- 32 A. All materials and workmanship shall be warranted against defects for a period of ten (10) years from the date of
33 Substantial Completion.

34
35 PART 2 PRODUCTS

36
37 2.1 BULLET RESISTANT FIBERGLASS MATERIAL

- 38
39 A. The panels shall be made of multiple layers of starch-oil woven roving ballistic grade fiberglass cloth impregnated
40 with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials
41 used shall provide the controlled internal delamination to permit the encapture of a penetrating projectile.
- 42 B. Manufacturing technique and material application of the Bullet Resistant Fiberglass shall be of the "non-ricochet
43 type". This design is intended to permit the encapture and retention of an attacking projectile lessening the
44 potential of a random injury or lateral penetration.
- 45 C. Bullet resistance of joints: Equal to that of the panel.

46 2.2 SECURITY LEVEL

- 47 A. The Bullet Resistant Fiberglass must be UL LISTED RATED for level 3.

48 2.3 MATERIALS

- 49 A. Panels fabricated of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset
50 polyester resin and compressed into flat rigid sheets.
- 51 B. Thickness: 7/16" nominal thickness.
- 52 C. NominalWeight: 4.8 lbs. per sq. ft.
- 53 D. Available Panel Sizes: 3' x 8', 3' x 9', 3' x 10, 4' x 8', 4' x 9, 4' x 10'

54
55 PART 3 EXECUTION

56
57 3.1 SUPPORTING MEMBERS

- 58
59 A. Prior to installing the bullet resistive material the contractor shall verify that all supports have been installed to the
60 point where work of this section may properly commence.

61
62 3.2 JOINTS

- 63
64 A. All joints shall be reinforced by a back-up layer of bullet resistive material. The bullet resistance of the joint, as
65 reinforced, shall be at least equal to that of the panel. Minimum width of reinforcing layer at joint shall be 4".

66
67 3.3 APPLICATION

- 68
69 A. Armor shall be installed in accordance with the manufacturer's printed recommendations. Armor panels shall be
70 adhered using screws. Method of application shall maintain the bullet resistive rating at junctures with the concrete
71 floor slab, the concrete roof slab, the bullet resistive door frames, the bullet resistive window frames, and all required
72 penetrations.

73
74 END OF SECTION 102641

1 SECTION 102800 – TOILET AND BATH ACCESSORIES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Public-use washroom accessories.
9 2. Public-use shower room accessories.
10 3. Private-use bathroom accessories.
11 4. Warm-air dryers.
12 5. Childcare accessories.
13 6. Custodial accessories.

14 B. Related Requirements:

- 15 1. Section 088300 "Mirrors" for frameless mirrors.

16 1.3 COORDINATION

- 17 A. Coordinate accessory locations with other work to prevent interference with clearances required for access by
18 people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

- 19 B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

20 1.4 ACTION SUBMITTALS

21 A. Product Data: For each type of product.

- 22 1. Include construction details, material descriptions, dimensions of individual components and profiles, and
23 finishes.
24 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and
25 substrate preparation.
26 3. Include electrical characteristics.

27 B. Sustainable Design Submittal:

- 28
29 1. Product Data for Credit EA 1: For products contributing to increased energy performance, provide
30 manufacturer documentation of use and non-use energy consumption.
31 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
32 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
33 product having recycled content.
34 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
35 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,

1 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
2 material, and fraction by weight that is considered regional.

3 C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

4 1. Identify locations using room designations indicated.

5 2. Identify accessories using designations indicated.

6 1.5 INFORMATIONAL SUBMITTALS

7 A. Sample Warranty: For manufacturer's special warranty.

8 1.6 CLOSEOUT SUBMITTALS

9 A. Maintenance Data: For accessories to include in maintenance manuals.

10 1.7 WARRANTY

11 A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials
12 or workmanship within specified warranty period.

13 1. Failures include, but are not limited to, visible silver spoilage defects.

14 2. Warranty Period: **15** years from date of Substantial Completion.

15 PART 2 - PRODUCTS

16 2.1 PERFORMANCE REQUIREMENTS

17 A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing
18 agency, and marked for intended location and application.

19 2.2 ACCESSORIES

20 A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.

21 B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be
22 incorporated into the Work include, but are not limited to, the following:

23

24 1. A & J Washroom Accessories, Inc.

25 2. American Specialties, Inc.

26 3. Bobrick Washroom Equipment, Inc.

27 4. Bradley Corporation.

28 5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

29 6. Tubular Specialties Manufacturing, Inc.

30 C. Toilet Tissue (Roll) Dispenser (TA-5):

31 1. Basis of design: Bobrick B-4388

32 2. Description: **Roll-in-reserve dispenser with hinged front secured with tumbler lockset.**

33 3. Mounting: **Recessed.**

- 1 4. Operation: **Noncontrol delivery with theft-resistant spindle.**
- 2 5. Capacity: Designed for **5-inch- (127-mm-)** diameter tissue rolls.
- 3 6. Material and Finish: **Stainless steel, No. 4 finish (satin).**

- 4 D. Toilet Tissue (Roll) Dispenser (TA-6):

- 5 1. Basis of design: Bobrick B-4288
- 6 2. Description: **Roll-in-reserve dispenser with hinged front secured with tumbler lockset.**
- 7 3. Mounting: Surface mounted.
- 8 4. Operation: **Noncontrol delivery with theft-resistant spindle.**
- 9 5. Capacity: Designed for **5-inch- (127-mm-)** diameter tissue rolls.
- 10 6. Material and Finish: **Stainless steel, No. 4 finish (satin).**

- 11 E. Waste Receptacle (TA-2):

- 12 1. Basis of design: Bobrick B-4288
- 13 2. Mounting: Freestanding, **open top for undercounter placement.**
- 14 3. Minimum Capacity: 21 **gal. (L)**>.
- 15 4. Material and Finish: **Stainless steel, No. 4 finish (satin).**

- 16 F. Liquid-Soap Dispenser (TA-3):

- 17 1. Basis of design: Bobrick B-4112
- 18 2. Description: Designed for dispensing soap in **liquid or lotion** form.
- 19 3. Mounting: **Horizontally oriented, surface mounted.**
- 20 4. Capacity: 40 **oz. (mL)**.
- 21 5. Lockset: Tumbler type.
- 22 6. Refill Indicator: Window type.

- 23 G. Grab Bar (TA-8, TA-9, TA-10):

- 24 1. Basis of design: Bobrick B-5806.99
- 25 2. Mounting: Flanges with **concealed** fasteners.
- 26 3. Material: Stainless steel, **0.05 inch (1.3 mm)** thick.

- 27 a. Finish: Smooth, No. 4 finish (satin) **with peened finish.**

- 28 4. Outside Diameter: **1-1/4 inches.**
- 29 5. Provide 258 series grab bar anchors for toilet partition installation.
- 30 6. Configuration and Length: **As indicated on Drawings.**

- 31 H. Coat Hook (TA-12):

- 32 1. Basis of design: Bobrick B-671
- 33 2. Description: **Single**-prong unit.
- 34 3. Material and Finish: **Stainless steel, No. 7 finish (polished).**

- 35 I. Coat Hook (TA-13):

- 36 1. Basis of design: Bobrick B-677
- 37 2. Description: **Single**-prong unit.
- 38 3. Material and Finish: **Stainless steel, No. 7 finish (polished).**

- 39 J. Mop and Broom Holder (TA-15):

- 40 1. Basis of design: Bobrick B-671
- 41 2. Description: **Unit with shelf, hooks, holders, and rod suspended beneath shelf.**

- 1 3. Length: **34 inches**.
- 2 4. Hooks: **Four**.
- 3 5. Mop/Broom Holders: **Three**, spring-loaded, rubber hat, cam type.
- 4 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- 5 a. Shelf: Not less than nominal **0.05-inch- (1.3-mm-)** thick stainless steel.
- 6 b. Rod: Approximately **1/4-inch- (6-mm-)** diameter stainless steel.
- 7 K. Sanitary-Napkin Disposal Unit (TA-7):
- 8 1. Basis of design: Bobrick B-270
- 9 2. Mounting: **Surface mounted**.
- 10 3. Door or Cover: Self-closing, disposal-opening cover.
- 11 4. Receptacle: Removable.
- 12 5. Material and Finish: **Stainless steel, No. 4 finish (satin)**.
- 13 L. Shelf (TA-14):
- 14 1. Basis of design: Bobrick B-270
- 15 2. Description: Surface mounted toiletry shelf..
- 16 3. Mounting: Concealed
- 17 4. Nominal Size: 24 **inches long by 4 3/4 inches (140 mm) wide with a 5 3/4 inch projection**.
- 18 5. Material and Finish: **Stainless steel, polished finish** .
- 19 M. Shower Curtain Rod (TA-16):
- 20 1. Basis of design: Bobrick B-6047
- 21 2. Description: **1-1/4-inch (32-mm) OD; fabricated from nominal 0.05-inch- (1.3-mm-) thick stainless steel**.
- 22 3. Mounting Flanges: **Stainless-steel flanges designed for exposed fasteners**.
- 23 4. Finish: **Stainless steel, No. 4 finish (satin)**.
- 24 N. Shower Curtain (TA-17):
- 25 1. Basis of design: Bobrick B-6047
- 26 2. Size: Minimum **6 inches (152 mm)** wider than opening by **72 inches (1828 mm)** high.
- 27 3. Material: **Vinyl, minimum 0.006 inch (0.15 mm) thick, opaque, matte>**.
- 28 4. Color: **White**.
- 29 5. Grommets: Corrosion resistant at minimum **6 inches (152 mm)** o.c. through top hem.
- 30 6. Shower Curtain Hooks: Stainless-steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.
- 31
- 32 O. Diaper-Changing Station (TA-11):
- 33 1. Basis of design: Bobrick KB200-05
- 34 2. Description: **Horizontal** unit that opens by folding down from stored position and with child-protection strap.
- 35
- 36 a. Engineered to support minimum of **250-lb (113-kg)** static load when opened.
- 37 3. Mounting: **Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed**.
- 38
- 39 4. Operation: By pneumatic shock-absorbing mechanism.
- 40 5. Material and Finish: **HDPE in manufacturer's standard color**.
- 41 6. Liner Dispenser: Built in.
- 42 P. Warm-Air Dryer (TA-1):

- 1 1. Basis of design: Bobrick XLERATOR XL-GR
- 2 2. Description: high-speed, warm-air hand dryer.
- 3 3. Mounting: **Surface mounted**.
- 4 4. Operation: **Electronic-sensor** activated with timed power cut-off switch.
- 5 a. Operation Time: **30 to 40** seconds.
- 6 5. Cover Material and Finish: Zinc die cast in textured graphite.
- 7 6. Electrical Requirements: **115 V, 13 A, 1500 W**.
- 8 7. Anti-Microbial Wall Guards: Microban Anti-microbial Wall Guards 31-3/4 inches by 15-3/4 inches by 1/16
- 9 inch deep with 1/2 inch radius corners with double sided construction grade 3M adhesive tape on the
- 10 mounting side. Brushed Stainless Steel Wall Guards.

11 2.3 MATERIALS

- 12 A. Stainless Steel: ASTM A 666, Type 304, **0.031-inch (0.8-mm)** minimum nominal thickness unless otherwise indicated.
- 13 B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), **0.036-inch (0.9-mm)** minimum
- 14 nominal thickness.
- 15 C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with **G60 (Z180)** hot-dip zinc coating.
- 16 D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- 17 E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant
- 18 where exposed, and of galvanized steel where concealed.
- 19 F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

20 2.4 FABRICATION

- 21 A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with
- 22 full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- 23 B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of **six**
- 24 keys to Owner's representative.

25 PART 3 - EXECUTION

26 3.1 INSTALLATION

- 27 A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate
- 28 indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and
- 29 at heights indicated.
- 30 B. Grab Bars: Install to withstand a downward load of at least **250 lbf (1112 N)**, when tested according to ASTM F 446.

31 3.2 ADJUSTING AND CLEANING

- 32 A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

- 1 B. Remove temporary labels and protective coatings.
- 2 C. Clean and polish exposed surfaces according to manufacturer's written instructions.
- 3 END OF SECTION 102800

1 SECTION 104413 - FIRE PROTECTION CABINETS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Fire-protection cabinets for the following:

- 9 a. Portable fire extinguishers.

- 10 B. Related Requirements:

- 11 1. Section 104416 "Fire Extinguishers."

12 1.3 ACTION SUBMITTALS

- 13 A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include
14 roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and
15 relationships of box and trim to surrounding construction.

- 16 B. Sustainable Design Submittal:

- 17 1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation
18 indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement
19 indicating cost for each product having recycled content.

- 20 2. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply
21 with requirements for regional materials, certificates indicating location of material manufacturer and point
22 of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project,
23 cost for each regional material, and fraction by weight that is considered regional.
24

- 25 C. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other
26 work.

- 27 D. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted.
28 Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and
29 function. **Use same designations indicated on Drawings.**

30 1.4 CLOSEOUT SUBMITTALS

- 31 A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

- 1 1.5 COORDINATION
- 2 A. Coordinate size of fire-protection cabinets to ensure that type and capacity of **fire extinguishers** indicated are
3 accommodated.
- 4 B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

5 PART 2 - PRODUCTS

6 2.1 PERFORMANCE REQUIREMENTS

- 7 A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-
8 resistance rating of walls where they are installed.

9 2.2 FIRE-PROTECTION CABINET

- 10 A. Cabinet Type: Suitable for fire **extinguisher**.
- 11 B. Cabinet Construction: **Nonrated**.
- 12 C. Cabinet Material: **Cold-rolled steel sheet**.
- 13 D. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- 14 E. Cabinet Trim Material: **Steel sheet**.
- 15 F. Door Material: **Steel sheet**.
- 16 G. Door Style: **Vertical duo panel with frame**.
- 17 H. Door Glazing: **Tempered float glass (clear)**.
- 18 I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and
19 door material and style indicated.
- 20 1. Provide **manufacturer's standard**.
- 21 2. Provide **manufacturer's standard hinge** permitting door to open 180 degrees.

22 PART 3 - Steel: Baked enamel or powder coat.

- 23 A. Materials:
- 24 1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
- 25 a. Finish: **Baked enamel or powder coat**.
- 26 b. Color: **As selected by Architect from full range of industry colors and color densities**.
- 27 2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, **Class 1 (clear)**.

- 1 3.2 FABRICATION
- 2 A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit
3 cabinet type, trim style, and door style indicated.
- 4 1. Weld joints and grind smooth.
5 2. Provide factory-drilled mounting holes.
6 3. Prepare doors and frames to receive locks.
- 7 B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated
8 with cabinet types and trim styles.
- 9 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum **1/2 inch (13 mm)**
10 thick.
11 2. Miter and weld perimeter door frames.
- 12 C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

13 3.3 GENERAL FINISH REQUIREMENTS

- 14 A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for
15 recommendations for applying and designating finishes.
- 16 B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable,
17 temporary protective covering before shipping.
- 18 C. Finish fire-protection cabinets after assembly.
- 19 D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of
20 adjoining components are acceptable if they are within the range of approved Samples and are assembled or
21 installed to minimize contrast.

22 PART 4 - EXECUTION

23 4.1 EXAMINATION

- 24 A. Examine roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
- 25 B. Examine walls and partitions for suitable framing depth and blocking where **recessed or semirecessed** cabinets will
26 be installed.
- 27 C. Proceed with installation only after unsatisfactory conditions have been corrected.

28 4.2 PREPARATION

- 29 A. Prepare recesses for **recessed** fire-protection cabinets if wall depth is sufficient for recessed cabinet. Prepare
30 recesses for **semirecessed** fire-protection cabinets if wall depth is insufficient for recessed cabinet.

- 1 4.3 INSTALLATION
- 2 A. General: Install fire-protection cabinets in locations and at mounting heights indicated **or, if not indicated, at**
3 **heights indicated below:**
- 4 1. Fire-Protection Cabinets: **54 inches (1372 mm)** above finished floor to top of cabinet.
- 5 B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- 6 1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for
7 recessed cabinets, provide semirecessed fire-protection cabinets.
- 8 4.4 ADJUSTING AND CLEANING
- 9 A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless
10 otherwise indicated in manufacturer's written installation instructions.
- 11 B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate
12 properly.
- 13 C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by
14 manufacturer.
- 15 D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished
16 appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and
17 mounting bracket manufacturers.
- 18 E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish
19 touchup or similar minor repair procedures.
- 20 END OF SECTION 104413

1 SECTION 104416 - FIRE EXTINGUISHERS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes portable, **hand-carried** fire extinguishers **and mounting brackets for fire extinguishers**.

- 8 B. Related Requirements:

- 9 1. Section 104413 "Fire Protection Cabinets."

10 1.3 ACTION SUBMITTALS

- 11 A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of
12 individual components and profiles, and finishes for fire extinguisher **and mounting brackets**.

- 13 B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet
14 schedule to ensure proper fit and function. **Use same designations indicated on Drawings**.

15 1.4 INFORMATIONAL SUBMITTALS

- 16 A. Warranty: Sample of special warranty.

17 1.5 CLOSEOUT SUBMITTALS

- 18 A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

19 1.6 COORDINATION

- 20 A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

21 1.7 WARRANTY

- 22 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire
23 extinguishers that fail in materials or workmanship within specified warranty period.

- 24 1. Failures include, but are not limited to, the following:

- 25 a. Failure of hydrostatic test according to NFPA 10.
26 b. Faulty operation of valves or release levers.

1 2. Warranty Period: **Six** years from date of Substantial Completion.

2 PART 2 - PRODUCTS

3 2.1 PERFORMANCE REQUIREMENTS

4 A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

5 B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency
6 acceptable to authorities having jurisdiction.

7 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

8 A. Fire Extinguishers: Type, size, and capacity for each **fire-protection cabinet and mounting bracket** indicated.

9 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that
10 may be incorporated into the Work include, but are not limited to, the following:

- 11 a. Amerex Corporation.
- 12 b. Ansul Incorporated; Tyco International Ltd.
- 13 c. Ansul Incorporated; Tyco International Ltd.
- 14 d. Badger Fire Protection; a Kidde company.
- 15 e. Buckeye Fire Equipment Company.
- 16 f. Fire End & Croker Corporation.
- 17 g. J. L. Industries, Inc.; a division of Activar Construction Products Group.
- 18 h. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
- 19 i. Larsen's Manufacturing Company.
- 20 j. Moon-American.
- 21 k. Pem All Fire Extinguisher Corp.; a division of PEM Systems, Inc.
- 22 l. Potter Roemer LLC.
- 23 m. Pyro-Chem; Tyco Safety Products.

24 2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

26 B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated **3-A:40-B:C, 5-lb (2.3-kg)** nominal capacity, with
27 monoammonium phosphate-based dry chemical in enameled-steel container.

28 2.3 MOUNTING BRACKETS

29 A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes
30 required for types and capacities of fire extinguishers indicated, with plated or **red** baked-enamel finish.

31 B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
32 Locate as indicated by Architect.

33 1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals
34 applied to mounting surface.

35 a. Orientation: **Vertical**.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

3 A. Examine fire extinguishers for proper charging and tagging.

4 1. Remove and replace damaged, defective, or undercharged fire extinguishers.

5 B. Proceed with installation only after unsatisfactory conditions have been corrected.

6 3.2 INSTALLATION

7 A. General: Install fire extinguishers **and mounting brackets** in locations indicated and in compliance with
8 requirements of authorities having jurisdiction.

9

10 1. Mounting Brackets: **54 inches (1372 mm)** above finished floor to top of fire extinguisher.

11 B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

12 END OF SECTION 104416

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1 SECTION 107500 – FLAG POLES

2 PART 1 - GENERAL

3 1.1 SUMMARY

4 A. Section Includes:
5 1. Ground-mounted flagpoles with LED down lights.

6 B. Related Sections:
7 1. 03 30 00 Cast-in-Place Concrete
8 2. Division 26 – Electrical
9

10 1.2 PERFORMANCE REQUIREMENTS

11 A. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of
12 gravity loads, and the following loads and stresses within limits and under conditions indicated according to the
13 following design criteria:
14 1. Base flagpole design on polyester, nylon or cotton flags of maximum standard size suitable for use with
15 flagpole or flag size indicated, whichever is more stringent.
16 2. Basic Wind Speed: 90 mph; 3-second gust speed at 33 feet aboveground.

17 1.3 SUBMITTALS

18 A. Shop Drawings: Submit shop drawings and product data for flagpoles and bases. Show general layout, jointing, and
19 complete anchoring and supporting systems.

20 1.4 SUBMITTALS

21 A. Prebid Submittals: Submit following with bid:
22 1. Substitution data.

23 B. Submittals for Review: Submit following in accordance with contract documents:
24 1. Product data.
25 2. Shop drawings.
26 3. Delegated-Design Submittal: Submit statement, signed and sealed by responsible design professional, for
27 each product and system specifically assigned to Contractor to be designed or certified by a design
28 professional, indicating that products and systems are in compliance with performance and design criteria
29 indicated. Include list of codes, loads, and other factors used in performing these services.

30 C. Contract Closeout Submittals: Submit following in accordance with contract documents:
31 1. Operation and maintenance data.
32 2. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name
33 and registered with manufacturer.

34 1.5 DELIVERY, STORAGE, AND HANDLING

35 A. Spiral wrap each flagpole with heavy Kraft paper or other suitable wrapping, and burlap covering, wood-strip and
36 steel-band prior to shipment.

37 B. Deliver flagpoles and accessories completely identified for installation procedure. Handle and store flagpoles to
38 prevent damage or soiling.

1 **PART 2 - PRODUCTS**

2 2.1 ALUMINUM FLAGPOLES

3 A. Fabricate aluminum flagpoles from seamless extruded aluminum tubing, ASTM B241, alloy 6063-T6, having a
4 minimum wall thickness of 3/16 in. (0.1875 in.), tensile strength not less than 30,000 psi and a yield point of 25,000
5 psi. Heat-treat and age-harden aluminum flagpoles.

6 B. Taper shall be manufacturer's standard seamless, uniform, straightline tapered section above a cylindrical butt
7 section. Unless otherwise shown, provide flagpole with uniform conical tapered section of 1 in. to each 5.5 ft of
8 run.

9 C. Provide cone tapered aluminum flagpole, 30 ft high.

10 D. Provide access for electrical connection.

11 2.2 BASE

12 A. Provide manufacturer's standard base system for the type of flagpole installation required.

13 B. Provide 16 ga minimum galvanized corrugated steel tube, or 12 ga rolled steel tube, sized to suit the flagpole and
14 installation. Furnish complete with welded steel bottom base and support plate, lightning ground spike, and steel
15 centering wedges, all welded construction. Provide loose hardwood wedges at top for plumbing pole after
16 erection. Galvanize steel parts after assembly, including foundation tube.

17 C. Provide flash collar, finished to match flagpole.

18 2.3 FINISH

19 A. Provide a very fine, non-directional, mechanical polish, natural clear anodized finish complying with AA-C22A41,
20 Class I (0.7 mil).

21 2.4 FLAGPOLE FITTINGS

22 A. Provide the following accessories specifically intended for flagpole furnished.

- 23 1. Ball - Flush seam, 14 ga spun aluminum, finished to match pole, size as shown.
- 24 2. Internal Halyard, Cam Cleat System halyard and concealed revolving truck assembly with rubber-coated
25 counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to
26 match flagpole. Provide snap hooks and retainer ring.
- 27 3. Double 5 Watt LED integral down lighting system

28 **PART 3 - EXECUTION**

29 3.1 EXCAVATION

30 A. Excavate for foundation concrete to neat clean lines in undisturbed soil. Provide forms where required due to
31 unstable soil conditions. Remove wood, loose soil, rubbish and other foreign matter from within excavation, and
32 wet the earth before placing concrete.

33 3.2 INSTALLATION

34 A. Install flagpoles plumb and as shown and in compliance with the shop drawings and the manufacturer's
35 recommendations.

36 B. Electrical connections and wiring shall be installed in accordance with Division 26 - Electrical and comply with
37 shop drawings and the manufacturer's recommendations.

1 C. Provide positive lightning ground for each flagpole installation.

2 END OF SECTION

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1 SECTION 122113 - HORIZONTAL LOUVER BLINDS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Horizontal louver blinds with **aluminum** slats.
9 2. Motorized operators.

10 1.3 ACTION SUBMITTALS

- 11 A. Product Data: For each type of product.

- 12 B. Samples for Initial Selection: For each type and color of horizontal louver blind.

- 13 1. Include Samples of accessories involving color selection.

- 14 C. Product Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

15 1.4 CLOSEOUT SUBMITTALS

- 16 A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

17 1.5 DELIVERY, STORAGE, AND HANDLING

- 18 A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of
19 installation using same designations indicated on Drawings.

20 1.6 FIELD CONDITIONS

- 21 A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet-work and finish work in
22 spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at
23 the levels indicated for Project when occupied for its intended use.

- 24 B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of
25 other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow
26 clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of
27 installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid
28 delaying the Work.

1 PART 2 - PRODUCTS

2 2.1 MANUFACTURERS

3 A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

4 2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS (WT-3)

5 A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work
6 include, but are not limited to, the following:

- 7
8 1. Hunter Douglas; Aluminum blinds.
9 2. Levolor, a Newell Rubbermaid Company; Riviera.
10 3. Springs Window Fashions Division, Inc.; Bali Lightblocker.

11 B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned
12 profile and radius corners.

- 13 1. Width: **1 inch (25 mm)**.
14 2. Thickness: **Not less than 0.008 inch (0.20 mm)**.
15 3. Spacing: **Manufacturer's standard**.
16 4. Finish: **ionized antistatic, dust-repellent, baked polyester finish**.
17 5. Features:

18 a. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of
19 slat to maximize slat overlap and minimize light gaps between slats.

20 C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled. Headrails fully enclose operating
21 mechanisms on three sides.

- 22 1. Capacity: **One** blind(s) per headrail unless otherwise indicated.
23 2. Ends: **Manufacturer's standard**.
24 3. Manual Lift Mechanism:

25 a. Lift-Cord Lock: **Variable; stops lift cord at user-selected position within blind full operating range**.
26 b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.

27 4. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.

- 28 a. Tilt: Full.
29 b. Operator: **Dual cord**.

- 30 5. Manual Lift-Operator and Tilt-Operator Lengths: **Manufacturer's standard**.
31 6. Manual Lift-Operator and Tilt-Operator Locations: **Manufacturer's standard** unless otherwise indicated.
32 7. Integrated Headrail/Valance: **Curved face**.

33 D. Bottom Rail: Formed-steel or extruded-aluminum tube that secures and protects ends of ladders and lift cords and
34 has plastic- or metal-capped ends.

- 35 1. Type: **Manufacturer's standard**.

36 E. Lift Cords: Manufacturer's standard braided cord.

37 F. Ladders: Evenly spaced across headrail at spacing that prevents long-term slat sag.

- 1 1. Type: **Braided cord.**
- 2 G. Valance: **Two slats.**
- 3 H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.
- 4 1. Type: **Overhead.**
- 5 I. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard.
- 6 J. Colors, Textures, Patterns, and Gloss:
- 7 1. Slats: **As selected by Architect from manufacturer's full range** [As indicated on Drawings.
- 8 2. Components: **Provide rails, cords, ladders, and materials exposed to view matching or coordinating with**
- 9 **slat color unless otherwise indicated.**

10 2.3 HORIZONTAL LOUVER BLIND FABRICATION

- 11 A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements
- 12 for corded, flexible, looped devices; lead content of components; and warning labels.
- 13 B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at **74 deg F (23 deg C)**:
- 14 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is
- 15 installed less **1/4 inch (6 mm)** per side or **1/2 inch (13 mm)** total, plus or minus **1/8 inch (3.1 mm)**. Length
- 16 equal to head-to-sill dimension of opening in which blind is installed less **1/4 inch (6 mm)**, plus or minus **1/8**
- 17 **inch (3.1 mm)**.
- 18 C. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
- 19 1. Lift-and-Tilt Mechanisms: With permanently lubricated moving parts.
- 20 D. Mounting Brackets: Designed for removal and reinstallation of blind without damaging blind and adjacent surfaces,
- 21 for supporting blind components, and for bracket positions and blind placement indicated.
- 22 E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to brackets and
- 23 adjoining construction; type designed for securing to supporting substrate; and supporting blinds and accessories
- 24 under conditions of normal use.
- 25 F. Color-Coated Finish:
- 26 1. Metal: For components exposed to view, apply manufacturer's standard baked finish complying with
- 27 manufacturer's written instructions for surface preparation including pretreatment, application, baking, and
- 28 minimum dry film thickness.

29 PART 3 - EXECUTION

30 3.1 EXAMINATION

- 31 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
- 32 tolerances, operational clearances, and other conditions affecting performance of the Work.
- 33 B. Proceed with installation only after unsatisfactory conditions have been corrected.

- 1 3.2 INSTALLATION
- 2 A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units
3 according to manufacturer's written instructions.
- 4 1. Locate so exterior slat edges are not closer than **1 inch (25 mm)** from interior faces of glass and not closer
5 than **1/2 inch (13 mm)** from interior faces of glazing frames through full operating ranges of blinds.
6 2. Install mounting brackets to prevent deflection of headrails.
7 3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating
8 hardware of glazed openings, other window treatments, and similar building components and furnishings.
- 9 3.3 ADJUSTING
- 10 A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.
- 11 3.4 CLEANING AND PROTECTION
- 12 A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.
- 13 B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures
14 that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.
- 15 C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time
16 of Substantial Completion.
- 17 END OF SECTION 122113

1 SECTION 122413 - ROLLER WINDOW SHADES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Manually operated top down roller shades with single rollers (WT-1).
9 2. Manually operated two tube bottom up roller shades (WT-2).

10 B. Related Requirements:

- 11 1. Section 061000 "Rough Carpentry" for wood blocking and grounds for mounting roller shades and
12 accessories.

13 1.3 ACTION SUBMITTALS

14 A. Product Data: For each type of product.

- 15 1. Include construction details, material descriptions, dimensions of individual components and profiles,
16 features, finishes, and operating instructions for roller shades.

17 B. Sustainable Design Submittal:

- 18
19 1. Product Data for Credit EA 1: For products contributing to increased energy performance, provide
20 manufacturer documentation of use and non-use energy consumption.
21 2. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
22 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
23 product having recycled content.
24 3. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
25 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
26 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
27 material, and fraction by weight that is considered regional.

28 C. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their
29 orientation to rollers, and their seam and batten locations.

30 D. Samples for Verification: For each type of roller shade.

- 31 1. Shadeband Material: Not less than 10 inches (250 mm) square. Mark interior face of material if applicable.
32 2. Roller Shade: Full-size operating unit, not less than 16 inches (400 mm) wide by 36 inches (900 mm) long for
33 each type of roller shade indicated.
34 3. Installation Accessories: Full-size unit, not less than 10 inches (250 mm) long.

35 E. Product Schedule: For roller shades.

- 1 1.4 CLOSEOUT SUBMITTALS
- 2 A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.
- 3 1.5 QUALITY ASSURANCE
- 4 A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation
5 using same designations indicated on Drawings.
- 6 1.6 FIELD CONDITIONS
- 7 A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including
8 painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels
9 indicated for Project when occupied for its intended use.
- 10 B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other
11 construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow
12 clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of
13 installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid
14 delaying the Work.
- 15 PART 2 - PRODUCTS
- 16 2.1 MANUFACTURERS
- 17 A. Source Limitations: Obtain roller shades from single source from single manufacturer.
- 18 2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS
- 19 A. Basis of Design Product: Subject to compliance with requirements, provide MechoShade Mecho/5 and 2-tube
20 Mecho/5 bottom up or a comparable product by one of the following:
21
- 22 1. Am-Source International
 - 23 2. BTX Window Automation, Inc.
 - 24 3. Custom Laminations, Inc.
 - 25 4. Draper Inc.
 - 26 5. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division;
 - 27 6. Levolor; Levolor Kirsch Window Fashions; a Newell Rubbermaid Company.
 - 28 7. Lutron Shading Solutions by VIMCO.
 - 29 8. Nysan Shading Systems, Ltd.
 - 30 9. Shade Techniques, Inc.
 - 31 10. Silent Gliss USA, Inc.
 - 32 11. SMAutomatic, Inc.
 - 33 12. Sol-R-Veil.
 - 34 13. Verosol USA, Inc.; OEM Shades, Inc.
- 35 B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement
36 when bead chain is released; permanently adjusted and lubricated.
- 37 1. Bead Chains: Stainless steel.
- 38 a. Loop Length: Full length of roller shade.

- 1 b. Limit Stops: Provide upper and lower ball stops.
2 c. Chain-Retainer Type: Chain tensioner, sill mounted.
- 3 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting
4 heavy roller shades.
- 5 a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by
6 manufacturer, whichever criterion is more stringent.
- 7 C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to
8 accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide
9 with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of
10 shadebands for service.
- 11 1. Roller Drive-End Location: Left side of interior face of shade.
12 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
13 3. Shadeband-to-Roller Attachment: Manufacturer's standard method.
- 14 D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating
15 mechanism, installation accessories, and mounting location and conditions indicated.
- 16 E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers
17 into a multiband shade that is operated by one roller drive-end assembly.
- 18 F. Shadebands:
- 19 1. Shadeband Material: Light-filtering fabric.
20 2. Pattern: Woven.
21 3. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
- 22 a. Type: Enclosed in sealed pocket of shadeband material.
- 23 G. Installation Accessories:
- 24 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and
25 attaches to roller endcaps without exposed fasteners.
- 26 a. Shape: L-shaped.
27 b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when
28 shade is fully open, but not less than 4 inches (102 mm).
29 2. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and
30 attaches to roller endcaps without exposed fasteners.
- 31 a. Shape: L-shaped.
32 b. Height: Manufacturer's standard height to conceal extended bracket as required to conceal roller
33 and shadeband assembly when shade is fully open, but not less than 5 inches (102 mm).
34 3. Installation Accessories Color and Finish: As selected from manufacturer's full range.
- 35 2.3 SHADEBAND MATERIALS
- 36 A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify
37 products with appropriate markings of applicable testing agency.
- 38 B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
- 39 1. Source: Roller shade manufacturer.

- 1 2. Type: PVC-coated polyester
- 2 3. Fabric Width: 72 inches or 96 inches to provide single width fabric in each window opening.
- 3 4. Orientation on Shadeband: Up the bolt.
- 4 5. Material Openess Factor: 0-1%.
- 5 6. Color: As selected by Architect from manufacturer's full range.

6 2.4 ROLLER SHADE FABRICATION

7 A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible,
8 chain-loop devices; lead content of components; and warning labels.

9 B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):

- 10 1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is
11 installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.1 mm). Length
12 equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or
13 minus 1/8 inch (3.1 mm).

14 C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

- 15 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens
16 and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment
17 through its full range of movement without distortion of the material.

18 PART 3 - EXECUTION

19 3.1 EXAMINATION

20 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
21 tolerances, operational clearances, and other conditions affecting performance of the Work.

22 B. Proceed with installation only after unsatisfactory conditions have been corrected.

23 3.2 ROLLER SHADE INSTALLATION

24 A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

- 25 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (51 mm) to interior face of glass.
26 Allow clearances for window operation hardware.

27 B. Roller Shade Locations: At exterior windows. Refer to plans for locations of top down and bottom up roller shades.

28 3.3 ADJUSTING

29 A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction
30 throughout entire operational range.

31 3.4 CLEANING AND PROTECTION

32 A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

- 1 B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure
- 2 that roller shades are without damage or deterioration at time of Substantial Completion.

- 3 C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of
- 4 Substantial Completion.

- 5 END OF SECTION 122413

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1 SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes plastic-laminate-clad countertops.

- 8 B. Related Requirements:

- 9 1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for
10 installing cabinets that are concealed within other construction before cabinet installation.
11 2. Section 064116 "Plastic-Laminate-Clad Architectural Cabinets."

12 1.3 COORDINATION

- 13 A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work
14 specified in other Sections to support loads imposed by installed and fully loaded cabinets.

15 1.4 ACTION SUBMITTALS

- 16 A. Product Data: For each type of product.

- 17 B. Sustainable Design Submittals:

- 18 1.
19 2. Product Data for Credit EQ 4.1: For installation adhesives, including printed statement of VOC content.
20 3. Product Data for Credit(s) MR 5: For products having recycled content, documentation indicating
21 percentages by weight of postconsumer and preconsumer recycled content.
22 a. Include statement indicating costs for each product having recycled content.
23 4. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
24 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
25 or recovery for each raw material.
26 a. Include statement indicating distance to Project, cost for each regional material, and fraction by
27 weight that is considered regional

- 28 C. Shop Drawings: For plastic-laminate-clad countertops.

- 29 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including
30 field joints.
31 2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.

- 32 D. Samples for Verification: As follows:

- 33 1. Plastic Laminates: For each type, color, pattern, and surface finish required, **8 by 10 inches (200 by 250 mm)**
34 in size.

- 1 2. Wood-Grain Plastic Laminates: For each type, color, pattern, and surface finish required, **12 by 24 inches**
- 2 **(300 by 600 mm)** in size.
- 3 3. Fabrication Sample: For each type and profile of countertop required, provide one sample applied to core
- 4 material with specified edge material applied to one edge.

5 1.5 INFORMATIONAL SUBMITTALS

- 6 A. Qualification Data: For fabricator.
- 7 B. Product Certificates: For the following:
- 8 1. High-pressure decorative laminate.
- 9 2. Adhesives.

10 1.6 QUALITY ASSURANCE

- 11 A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those
- 12 required for this Project and whose products have a record of successful in-service performance.

13 1.7 DELIVERY, STORAGE, AND HANDLING

- 14 A. Deliver countertops only after casework and supports on which they will be installed have been completed in
- 15 installation areas.
- 16 B. Store countertops in areas where environmental conditions comply with requirements specified in "Field
- 17 Conditions" Article.
- 18 C. Keep surfaces of countertops covered with protective covering during handling and installation.

19 1.8 FIELD CONDITIONS

- 20 A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete,
- 21 and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building
- 22 occupants during the remainder of the construction period.
- 23 B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other
- 24 construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate
- 25 fabrication schedule with construction progress to avoid delaying the Work.

26 PART 2 - PRODUCTS

27 2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- 28 A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of
- 29 plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
- 30
- 31 1. The Contract Documents contain requirements that are more stringent than the referenced quality
- 32 standard. Comply with requirements of Contract Documents in addition to those of the referenced quality
- 33 standard.

- 1 B. Grade: Custom.
- 2 C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
- 3
- 4 1. Basis of Design: Subject to compliance with requirements, provide product indicated on Drawings or
- 5 comparable product:
- 6 a. Abet Laminati, Inc.
- 7 b. Arborite; Division of ITW Canada, Inc.
- 8 c. Formica Corporation.
- 9 d. Lamin-Art, Inc.
- 10 e. Nevamar Company, LLC; Decorative Products Div.
- 11 f. Panolam Industries International Incorporated.
- 12 g. Westinghouse Electric Corp.; Specialty Products Div.
- 13 h. Wilsonart International; Div. of Premark International, Inc.
- 14 D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate
- 15 surfaces complying with the following requirements:
- 16 1. PL-2
- 17 a. Wilsonart 4588K-07 Kalahari Topaz.
- 18 E. Edge Treatment: Same as laminate cladding on horizontal surfaces.
- 19 F. Core Material: Particleboard.
- 20 G. Core Material at Sinks: Particleboard made with exterior glue.
- 21 H. Core Thickness: **3/4 inch (19 mm)**.
- 22 1. Build up countertop thickness to **1-1/2 inches (38 mm)** at front, back, and ends with additional layers of
- 23 core material laminated to top.
- 24 2.2 WOOD MATERIALS
- 25 A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise
- 26 indicated.
- 27 1. Wood Moisture Content: 5 to 10 percent.
- 28 B. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled
- 29 content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25
- 30 percent.
- 31 C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality
- 32 standard for each type of countertop and quality grade specified unless otherwise indicated.
- 33
- 34 1. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
- 35 2. Softwood Plywood: DOC PS 1.
- 36 2.3 ACCESSORIES
- 37 A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire
- 38 passage.
- 39
- 40 1. Outside Diameter: **2 inches (51 mm)**.

- 1 2. Color: Black,
- 2 2.4 MISCELLANEOUS MATERIALS
- 3 A. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for
4 VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
5
6 1. Wood Glues: 30 g/L.
7 2. Contact Adhesive: 250 g/L.
- 8 B. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement or Contact cement.
- 9 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.
- 10 2.5 FABRICATION
- 11 A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of **1 inch (25**
12 **mm)** over base cabinets. Ease edges to radius indicated for the following:
- 13 B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble
14 components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample
15 allowance for scribing, trimming, and fitting.
- 16 C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar
17 items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and
18 shaped openings. Sand edges of cutouts to remove splinters and burrs.
- 19 PART 3 - EXECUTION
- 20 3.1 PREPARATION
- 21 A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- 22 B. Before installing countertops, examine shop-fabricated work for completion and complete work as required,
23 including removal of packing.
- 24 3.2 INSTALLATION
- 25 A. Grade: Install countertops to comply with same grade as item to be installed.
- 26 B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
- 27 C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and
28 fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and
29 edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- 30 1. Secure field joints in countertops with concealed clamping devices located within **6 inches (150 mm)** of
31 front and back edges and at intervals not exceeding **24 inches (600 mm)**. Tighten according to
32 manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- 33 D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

- 1 E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into
2 underside of countertop.
- 3 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a **1/8-**
4 **inch-in-96-inches (3-mm-in-2400-mm)** variation from a straight, level plane.
- 5 2. Secure backsplashes to tops with concealed metal brackets at **16 inches (400 mm)** o.c.
- 6 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut
7 walls with mildew-resistant silicone sealant or another permanently elastic sealing compound
8 recommended by countertop material manufacturer.
- 9 3.3 ADJUSTING AND CLEANING
- 10 A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not
11 possible to repair, replace countertops. Adjust joinery for uniform appearance.
- 12 B. Clean countertops on exposed and semiexposed surfaces.
- 13 C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of
14 countertop at a minimum of **48 inches (1220 mm)** o.c. Remove protection at Substantial Completion.
- 15 END OF SECTION 123623.13

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1 SECTION 123661.16 - SOLID SURFACING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Solid surface material countertops.
9 2. Stainless Steel countertops.
10 3. Solid surface material back and end splashes.
11 4. Solid surface material sinks.
12 5. Solid surface material shower walls.
13 6. Solid surface material window sills.

14 1.3 ACTION SUBMITTALS

15 A. Product Data: For materials and sinks.

16 B. Sustainable Design Submittals:

- 17
18 1. Product Certificates for Credit EQ 4.1: Product data for adhesives and sealants, including printed statement
19 of VOC content.
20 2. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that
21 product contains no urea formaldehyde.
22 3. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation
23 indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement
24 indicating cost for each product having recycled content.
25 4. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply
26 with requirements for regional materials, certificates indicating location of material manufacturer and point
27 of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project,
28 cost for each regional material, and fraction by weight that is considered regional.
29 5. Credit EQ 4: Laboratory test reports for adhesives and sealants indicating that they meet the testing and
30 product requirements of the California Department of Health Services' "Standard Practice for the Testing of
31 Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including
32 2004 Addenda.

33 C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and
34 cutouts for plumbing fixtures.

- 35
36 1. Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices and
37 other components.
38 2. Show full-size details, edge details, thermoforming requirements, attachments, etc.
39 3. Show locations and sizes of furring, blocking, including concealed blocking and reinforcement specified in
40 other Sections.
41 4. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, soap dispensers, waste
42 receptacle and other items installed within countertop.

- 1 5. Show materials, finishes, edge and backsplash profiles, methods of joining.
- 2 D. Samples for Initial Selection: For each type of material exposed to view.
- 3
- 4 1. Submit minimum 6-inch by 6-inch sample in specified gloss.
- 5 2. Cut sample and seam together for representation of inconspicuous seam.
- 6 3. Indicate full range of color and pattern variation.
- 7 1.4 INFORMATIONAL SUBMITTALS
- 8 A. Qualification Data: For fabricator/installer.
- 9 1.5 CLOSEOUT SUBMITTALS
- 10 A. Maintenance Data: For countertops to include in maintenance manuals. Include Product Data for care products
11 used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
- 12 1.6 QUALITY ASSURANCE
- 13 A. Fabricator Qualifications:
- 14
- 15 1. Shop that employs skilled workers who custom-fabricate countertops similar to that required for this
16 Project, and whose products have a record of successful in-service performance.
- 17 2. Work of this section shall be by a certified fabricator/installer, certified in writing by the manufacturer.
- 18 B. Fire test response characteristics:
- 19
- 20 1. Provide with the following Class A (Class I) surface burning characteristics as determined by testing identical
21 products per UL 723 (ASTM E84) or another testing and inspecting agency acceptable to authorities having
22 jurisdiction:
- 23 a. Flame Spread Index: 25 or less.
- 24 b. Smoke Developed Index: 450 or less.
- 25 1.7 FIELD CONDITIONS
- 26 A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is
27 complete.
- 28 1.8 COORDINATION
- 29 A. Coordinate locations of utilities that will penetrate countertops or backsplashes.
- 30 1.9 WARRANTY
- 31 A. Provide manufacturer's warranty against defects in materials.
- 32
- 33 1. Warranty shall provide material and labor to repair or replace defective materials.
- 34 B. Manufacturer's warranty period:
- 35
- 36 1. Ten years from date of substantial completion.

1 PART 2 - PRODUCTS

2 2.1 SOLID SURFACE MATERIALS

- 3 A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
- 4 B. Basis-of-Design Product: Subject to compliance with requirements, provide surfaces from LG Hausys or comparable
5 product by one of the following:
6
- 7 1. Avonite Surfaces.
 - 8 2. Formica Corporation.
 - 9 3. North Star Surfaces, LLC.
 - 10 4. Wilsonart International.
 - 11 5. E. I. du Pont de Nemours and Company.
- 12 C. Type: Provide Standard type.
- 13 D. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
- 14 E. Particleboard: ANSI A208.1, Grade M-2 or Grade M-2-Exterior Glue.
- 15 F. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

16 2.2 COUNTERTOP FABRICATION

- 17 A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the
18 AWI/AWMAC/WI's "Architectural Woodwork Standards."
- 19 1. Grade: Custom.
- 20 B. Colors and Patterns:
- 21 1. SS-1
22 Manufacturer: LG Hausys Hi-Macs
23 Color: VC04 Pavao
24
- 25 C. Configuration:
- 26 1. Front: Straight, slightly eased at top with separate apron, 6 inches (150 mm) high, recessed 1/4-inch (6.4-
27 mm) behind front edge.
 - 28 2. Backsplash: Straight, slightly eased at corner.
 - 29 3. End Splash: Matching backsplash.
- 30 D. Countertops: 1/2-inch- (12.7-mm-) thick, solid surface material with front edge built up with same material.
- 31 E. Backsplashes: 1/2-inch- (12.7-mm-) thick, solid surface material.
- 32 F. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material
33 manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- 34 1. Fabricate with loose backsplashes for field assembly.
 - 35 2. Install integral sink bowls in countertops in the shop.
- 36 G. Joints: Fabricate countertops without joints.

- 1 H. Integral bowl: Dupont model 820.
- 2 I. Cutouts and Holes:
- 3 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by
4 fixture manufacturer. Form cutouts to smooth, even curves.
- 5 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-
6 mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of
7 largest radius practical.
- 8 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

9 2.3 SHOWER SURROUNDS

10 A. Colors and Patterns:

- 11 1. SS-2
12 Manufacturer: LG Hausys Hi-Macs
13 Color: Merino GT914
14

15 B. Configuration: Provide shower surrounds with the following:

- 16 1. Edges: Straight, slightly eased at top.
17 2. Surrounds: 1/4-inch- thick, solid surface material.
18 3. Fabrication: Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers,
19 fabrication, and finishing. Aligning sheets to be seamed together using butt or tongue and groove joints, no
20 silicone soft seams.
21

22 C. Shower shelf:

- 23 1. Edges: Straight, slightly eased.
24 2. Surrounds: 1/2-inch- thick, solid surface material.
25 3. Shelf: 1/2-inch- thick, solid surface material.
26 4. Fabrication: Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers,
27 fabrication, and finishing. Provide 4 drainage grooves radiating from corner and starting 1 1/2" from the
28 corner.
29 5. Size: as indicated on the drawings.
30 6. Mounting: as indicated on the drawings.
31

32 2.4 WINDOW SILLS

33 A. Configuration: Provide window sills with the following front edge style:

- 34 B. Front: Straight, slightly eased at top.
35 C. Sills: 1/2-inch- thick, solid surface material with front edge built up with same material.
36 D. Fabrication: Fabricate sills in one piece with shop-applied edges unless otherwise indicated. Comply with solid-
37 surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

38 E. Colors and Patterns:

- 39 1. SS-5
40 Manufacturer: LG Hausys Hi-Macs
41 Color: M308 Haze
42

- 1 2.5 STAINLESS STEEL COUNTERTOPS
- 2 A. Configuration: as indicated on drawings.
- 3 B. Tops: Form tops with 1 1/4" high edges with 1/2" return flange. Reinforce with marine-grade plywood backer.
- 4 C. Front: Straight, Box Marine.
- 5 D. Construction: 16 gauge, type 304 stainless.
- 6 E. Finish: #4.
- 7 F. Back and side splash: 10-inch- high x 1" deep, with a 45-degree return.
- 8 G. Fabrication:
- 9 1. Form edges, flanges, and backslashes integrally from one sheet of steel.
- 10 2. Cove corner at side / back splash intersection.
- 11 H. Installation: Z-clip attached to wall.
- 12 2.6 INSTALLATION MATERIALS
- 13 A. Adhesive: Product recommended by solid surface material manufacturer.
- 14 1. Do not use adhesives that contain urea formaldehyde.
- 15 B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."
- 16 C. Sink/lavatory mounting hardware:
- 17
- 18 1. Manufacturer's standard bowl clips, panel inserts and fasteners for attachment of undermount
- 19 sinks/lavatories.
- 20 D. Conductive tape:
- 21
- 22 1. Manufacturer's standard aluminum foil tape, with required thickness, for use with cutouts near heat
- 23 sources.
- 24 E. Insulating felt tape:
- 25
- 26 1. Manufacturer's standard for use with conductive tape in insulating solid surface material from adjacent
- 27 heat source.
- 28 F. Steel Countertop Support Brackets:
- 29
- 30 1. 2-inch wide x 3/8" thick bent steel plate bracket in sizes as indicated on the drawings.
- 31 2. Basis of Design: ShortRun Pro, Freedom Granite Countertop Bracket.
- 32 3. Provide basis of design or equal product.
- 33 G. Aluminum Countertop Support Brackets:
- 34
- 35 1. 2-inch x 2-inch "T" bracket for surface mounted installation.
- 36 2. Provide Rakks/Rangine Corporation model # EH-1212 or EH1209 as required per countertop depth.
- 37 3. Material: 6063 T-6 extruded aluminum.
- 38 4. Finish: Primed.
- 39 2.7 Performance characteristics:
- 40 A. Property Typical Result Test
- 41 B. Tensile Strength 6,000 psi ASTM D 638
- 42 C. Tensile Modulus 1.35 x 10⁶ psi ASTM D 638
- 43 D. Tensile Elongation 0.5% min. ASTM D 638

1	E.	Flexural Strength	8,000 psi	ASTM D 790
2	F.	Flexural Modulus	1.34 x 10 ⁶ psi	ASTM D 790
3	G.	Hardness	>60	Rockwell "M"
4	H.	Flammability	All colors	ASTM E 84,
5	I.	(Class I and Class A)	NFPA 255 & UL 723	
6	J.	Flame Spread Index	<25	
7	K.	Smoke Developed Index	<25	

8 PART 3 - EXECUTION

9 3.1 EXAMINATION

10 A. Examine substrates to receive countertops and conditions under which countertops will be installed, with Installer
 11 present, for compliance with requirements for installation tolerances and other conditions affecting performance of
 12 countertops.

13 B. Proceed with installation only after unsatisfactory conditions have been corrected.

14 3.2 INSTALLATION

15 A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not
 16 exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.

17 B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for
 18 screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match
 19 countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove
 20 surface scratches, and clean entire surface.

21 C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align
 22 subtops in a level plane.

23 D. Secure countertops to subtops with adhesive according to manufacturer's written instructions. Align adjacent
 24 surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written
 25 instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

26 E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of
 27 countertops and splashes adjacent to joints to prevent adhesive smears.

28 F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints
 29 to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by
 30 manufacturer.

31 G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while
 32 cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling
 33 is required for clearance. Ease edges slightly to prevent snipping.

34 H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

35 3.3 Integral sinks/vanities:

36 A. Provide solid surface materials bowls and/or lavatories sinks with overflows in locations shown on the drawings.

- 1 B. Secure sinks and lavatory bowls to tops using manufacturer's recommended sealant, adhesive and mounting
- 2 hardware to maintain warranty.

- 3 3.4 Backsplashes and side splashes.

- 4 A. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers,
- 5 fabrication, and finishing.

- 6 3.5 REPAIR

- 7 A. Repair or replace damaged work which cannot be repaired to architect's satisfaction.

- 8 3.6 CLEANING AND PROTECTION

- 9 A. Keep components clean during installation.
- 10 B. Remove adhesives, sealants and other stains.

- 11 END OF SECTION 123661.16

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1 SECTION 123665 – EPOXY RESIN COUNTERTOPS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Epoxy resin worksurfaces and accessories.

- 8 B. Setting materials.

9 1.3 REFERENCES

- 10 A. D570 - Standard Test Method for Water Absorption of Plastics.

- 11 B. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal
12 Position.

- 13 C. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Oad in edgewise Position.

- 14 D. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

- 15 E. D696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30⁰ C and 30⁰ C With
16 a Vitreous Silica Dilatometer.

- 17 F. D785 - Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials.

- 18 G. D790 - Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical
19 Insulating Materials.

- 20 H. D792 - Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

- 21 I. D3801 - Standard Test Method for Measuring the Comparative Burning Characteristics of Solid Plastics in a Vertical
22 Position.

- 23 J. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

24 1.4 ACTION SUBMITTALS

- 25 A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details,
26 dimensions of individual components and profiles, features, and finishes.

- 27 B. Sustainable Design Submittals:

- 28
29 1. Product Certificates for Credit EQ 4.1: Product data for adhesives and sealants, including printed statement
30 of VOC content.

- 1 2. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that
2 product contains no urea formaldehyde.
- 3 3. Product Data for Credit MR 5: For products having recycled content, documentation indicating percentages
4 by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each
5 product having recycled content.
- 6 4. Product Certificates for Credit MR 4: For products and materials required to comply with requirements for
7 regional materials, certificates indicating location of material manufacturer and point of extraction, harvest,
8 or recovery for each raw material. Include statement indicating distance to Project, cost for each regional
9 material, and fraction by weight that is considered regional.
- 10 5. Credit EQ 4: Laboratory test reports for adhesives and sealants indicating that they meet the testing and
11 product requirements of the California Department of Health Services' "Standard Practice for the Testing of
12 Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," including
13 2004 Addenda.

14 C. Shop Drawings:

- 15
- 16 1. Submit plan, section, elevation and perspective drawings necessary to describe and convey layout, profiles,
17 and product components, including edge conditions, joints, fitting and fixture locations, anchorage,
18 accessories, and finish colors.
- 19 2. Verify actual measurements/openings by field measurements before fabrication; show recorded
20 measurements on Shop Drawings.
- 21 3. Coordinate field measurements and fabrication schedule with construction progress to avoid construction
22 delays.

23 D. Samples:

- 24
- 25 1. Selection samples: For each finish product specified, submit complete set of color chips representing
26 manufacturer's full range of standard colors.
- 27 2. Verification samples: For each finish product specified, submit samples representing actual product color;
28 supplied product color and gloss may vary slightly from supplied samples.
- 29 3. Quality Control Submittals:
 - 30 a. Test Reports: Certified test reports or recognized evaluation reports showing compliance with
31 specified performance characteristics and physical properties

32 E. Maintenance Data:

- 33
- 34 1. Provide maintenance, cleaning, and life cycle information.
- 35 2. Include recommended cleaning materials and procedures, and list of materials detrimental to epoxy resin.

36 1.5 QUALITY ASSURANCE

- 37 A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those
38 required for this Project and whose products have a record of successful in-service performance.

39 1.6 DELIVERY, STORAGE, AND HANDLING

40 A. Delivery:

- 41
- 42 1. Use pallets larger than sheets during transportation.
- 43 2. Package materials to prevent damage during shipping and handling.

44 B. Storage:

- 45
- 46 1. Store products in enclosed area protected from ultraviolet.
- 47 2. Store products in manufacturer's unopened packaging until ready for installation.
- 48 3. Store panels using protective dividers to avoid damage to surfaces.

- 1 4. For horizontal storage, store sheets on pallets of equal or greater size than sheets with protective layer
- 2 between pallet and sheet and on top of uppermost sheet.
- 3 5. Do not store sheets or fabricated panels vertically.

4 C. Handling:

- 5
- 6 1. If protective film is provided, do not remove until panel has been installed.
- 7 2. Handle sheets to prevent damage.
- 8 3. Remove stickers immediately after installation.

9 1.7 FIELD CONDITIONS

- 10 A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete,
- 11 and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building
- 12 occupants during the remainder of the construction period.
- 13 B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other
- 14 construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate
- 15 fabrication schedule with construction progress to avoid delaying the Work.

16 PART 2 - PRODUCTS

17 2.1 MANUFACTURES

- 18 A. Product: Subject to compliance with requirements, provide Durcon, Incorporated or a comparable product.

19 2.2 Materials

20 A. Solid Epoxy Resin: SS-3

- 21
- 22 1. Sheets cast from modified epoxy resin and non-asbestos inert fillers; compounded mixture cured and
- 23 thermoset specifically from formulation to provide exceptional physical and chemical resistance.
- 24 2. Sheets monolithic throughout without surface coating application and shall have a uniform low-sheen
- 25 surface.
- 26 3. Physical properties; minimum acceptable physical performance in accordance with SEFA 3 testing
- 27 procedures:
- 28 4. Density/specific gravity: Tested to ASTM D792; minimum test rating of 134.8 PSF or 2.16 gcm.
- 29 5. Rockwell hardness: Tested to ASTM D785; minimum M scale rating of 110.
- 30 6. Fire resistance: tested to ASTM D635; classified as self-extinguishing.
- 31 7. Surface burning characteristics: Tested to ASTM E84; flame spread index 7.4 and smoke develop index of
- 32 221.2.
- 33 8. Surface burning characteristics in vertical position: Tested to ASTM D3801; maximum flame spread index of
- 34 7.4 and smoke developed index of 221.2.
- 35 9. Coefficient of linear thermal expansion: Tested to ASTM D696; rating of 2.46 x 10-5.
- 36 10. Heat deflection: Tested to ASTM D648; maximum 205 degrees F or 96 degrees C.
- 37 11. Flexural strength: Tested to ASTM D790; minimum rating 14.9 KPSI or 103 Mpa.
- 38 12. Flexural modulus: Tested to ASTM D790; 2,777,501 PSI or 19.2 Gpa.
- 39 13. Water absorption, 24 hours: tested to ASTM D570; maximum 0.008 percent by weight.
- 40 14. Compression strength: Tested to ASTM D695; minimum 38.4 kpsi or 265 Mpa.
- 41 15. Chemical resistance; minimum acceptable chemical resistance performance in accordance with SEFA 8:

42

43 16. Reagent Tested Method Rating

44

1	Amyl Acetone	A	0
2	Ethyl Acetate	A	1
3	Acetic Acid 98%	B	0
4	Acetone	A	1
5	Acid Dichromate 5%	B	0
6	Butyl Alcohol	A	0
7	Ethyl Alcohol	A	0
8	Methyl Alcohol	A	0
9	Ammonium Hydroxide, 28%	B	0
10	Benzene	A	1
11	Carbon Tetrachloride	A	0
12	Chloroform	A	1
13	Chromic Acid 60%	B	0
14	Cresol	A	0
15	Dichloro Acetic Acid	A	0
16	Dimethylformamide	A	0
17	Dioxane	A	1
18	Ethyl Ether	A	0
19	Formaldehyde 37%	A	0
20	Formic Acid 90%	B	1
21	Furfural	A	0
22	Gasoline	A	0
23	Hydrochloric Acid, 37%	B	0
24	Hydroflouric Acid 48%	B	3
25	Hydrogen Peroxide 28%	B	0
26	Tincture of Iodine	B	0
27	Methyl Ethyl Ketone	A	1
28	Methylene Chloride	A	1
29	Mono Chlorobenzene	A	1
30	Napthalene	A	0
31	Nitric Acid, 20%	B	0
32	Nitric Acid, 30%	B	0
33	Nitric Acid, 70%	B	0
34	Phenol 90%	A	0
35	Phosphoric Acid, 85%	B	0
36	Silver Nitrate, Saturated	B	0
37	Sodium Hydroxide, 10%	B	0
38	Sodium Hydroxide, 20%	B	1
39	Sodium Hydroxide, 40%	B	1
40	Sodium Hydroxide, Flake	B	0
41	Sodium Sulfide, Saturated	B	0
42	Sulfuric Acid, 25%	B	0
43	Sulfuric Acid, 85%	B	1
44	Sulfuric Acid, 96%	B	3
45	Sulfuric Acid 85%, and Nitric Acid 70%, equal parts	B	1
46	Toluene	A	0
47	Trichlorethylene	A	1
48	Xylene	A	0
49	Zinc Chloride, Saturated	B	0

- 50
- 51 17. Testing Method Descriptions:
- 52 a. Method A - Volatile chemicals (organic solvents): Cotton ball saturated with test reagent is placed in
- 53 one-ounce bottle (20 x 75mm test tube or similar container) with reservoir of liquid above ball.
- 54 Container is inverted on test material for period of 24 hours at standard temperature 23 degrees C
- 55 plus or minus 2 degrees C (73 degrees F plus or minus 4 degrees F).
- 56 b. Method B - Non Volatile Chemicals: Five drops (1/4 cc) of test reagent are placed on test material
- 57 surface. Reagent is then covered with watch glass (25 mm) for period of no less than 24 hours at

- 1 standard temperature of 23 degrees C plus or minus 2 degrees C (73 degrees F plus or minus 4
2 degrees F).
- 3 18. Result Definitions:
- 4 19. 0 - No Effect: No detectable change in material surface.
- 5 20. 1 - Good: Slight detectable change in color or gloss but no change to function or life of work surface
6 material.
- 7 21. 2 - Fair: Slight surface etching or severer staining. Clearly discernable change in color or gloss but no
8 significant impairment of surface life or function.
- 9 22. 3 - Poor: Pitting, cratering or erosion of work surface material; obvious and significant deterioration.
10 Objectionable change in appearance due to surface discoloration.
- 11 23. Color: Black or Gray as indicated on drawings.

12 B. Fabrication

- 13
- 14 1. Fabricated tops and accessories in accordance with manufacturer's recommendations, approved Shop
15 Drawings, and SEFA 8.
- 16 2. Epoxy Resin Worksurfaces:
- 17 a. 1 inch unless otherwise indicated.
- 18 b. Check each sheet at factory for required thickness.
- 19 c. Maximum variation in thickness: plus or minus 1/16 inch from corner to corner.
- 20 3. Warpage:
- 21 a. Inspect tops for warpage prior to fabrication by placing on true flat surface.
- 22 b. Maximum allowable warpage: 1/16 inch in 36 inch span or 3/16 inch in 96 inch span.
- 23 4. Fabrication:
- 24 a. Shop fabricate in longest practical lengths.
- 25 b. Bond joints with highly chemical resistant cement with properties and color similar to base material.
- 26 c. Provide 1/8 inch drip groove at underside of exposed edges, set back 1/2 inch from face.
- 27 d. Finish exposed edges.
- 28 e. Fabricate tops flat with 1/4 inch raised marine edge.
- 29 f. Edge treatment: Standard 1/8 inch chamfered edge.
- 30
- 31 g. Corner treatment: exposed corners shall be eased slightly for safety.
- 32
- 33 h. Back and end splashes:
- 34 i. Supplied loose for field installation
- 35 j. Same material and thickness as tops.
- 36 k. 4 inches high unless otherwise indicated.
- 37 l. Top-mounted end splash where worksurfaces abut adjacent construction and locations indicated on
38 Drawings.
- 39
- 40 m. Joints:
- 41 n. Maximum 1/8 inch, bonded with epoxy grout.
- 42 o. Make joints between two benches level.
- 43 p. Locate joints away from sinks and over or near supports.
- 44
- 45 q. Sink cutouts: Routed for undermount sink.
- 46
- 47 r. Allowable tolerances:
- 48 s. Square: Plus or minus 1/64 inch for each 12 inches of length.
- 49 t. Location of cutouts and drilled openings: Plus or minus 1/8 inch of design dimension.
- 50 u. Size of cutouts and drilled openings: Plus 1/8 inch or minus 0 inches.

1 PART 3 - EXECUTION

2 3.1 EXAMINATION

- 3 A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation
4 tolerances, clearances, accurate locations of connections and other conditions affecting performance of the Work.
- 5 B. Do not begin installation until cabinets have been installed.
- 6 C. Confirm that surfaces to receive tops are plumb and level, with maximum deflection of 1/4 inch in 20 feet.
- 7 A. Proceed with installation only after unsatisfactory conditions have been corrected

8 3.2 PREPARATION

- 9 A. Clean surfaces just prior to installation.
- 10 B. Prepare surfaces using methods recommended by manufacturer.

11 3.3 INSTALLATION

- 12 A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
- 13 B. Install tops plumb and level.
- 14 C. Scribe to adjacent surfaces in accordance with manufacturer's recommendations.
- 15 D. Fasten tops to supporting construction with adhesives appropriate for use with adjoining construction and as
16 recommended by manufacturer.
- 17 E. Form field joints using manufacturer's recommended adhesive. Form joints to be inconspicuous and nonporous.
- 18 F. Install laboratory fume hood base work surfaces using fasteners and adhesive appropriate for use with adjoining
19 construction and as recommended by manufacturer

20 3.4 CLEANING AND PROTECTION

- 21 A. Clean surfaces after installation, according to manufacturer's written instructions.
- 22 B. Clean surfaces after installation, according to manufacturer's written instructions.
- 23 C. Replace damaged tops that cannot be repaired, in a manner approved by Architect, before time of Substantial
24 Completion.

25 END OF SECTION 123665

1 SECTION 142400 - HYDRAULIC ELEVATORS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section includes hydraulic passenger elevators.

8 B. Related Requirements:

- 9 1. Section 015000 "Temporary Facilities and Controls" for temporary use of elevators for construction
10 purposes.
11 2. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
12 3. Section 042000 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for
13 grouting elevator entrance frames installed in masonry walls.
14 4. Section 055000 "Metal Fabrications" for the following:
- 15 a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - 16 b. Hoist beams.
 - 17 c. Structural-steel shapes for subsills.
 - 18 d. Pit ladders.

19 1.3 DEFINITIONS

20 A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

21 B. Service Elevator: A passenger elevator that is also used to carry freight.

22 1.4 ACTION SUBMITTALS

23 A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
24 Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.

25 B. Shop Drawings:

- 26 1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room
27 layout; coordination with building structure; relationships with other construction; and locations of
28 equipment.
29 2. Include large-scale layout of car-control station and standby-power operation control panel.
30 3. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as
31 maximum and average power demands.

- 1 1.5 INFORMATIONAL SUBMITTALS
- 2 A. Qualification Data: For Installer.
- 3 B. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout
4 and dimensions, as shown on Drawings, and electrical service including standby-power generator, as shown and
5 specified, are adequate for elevator system being provided.
- 6 C. Sample Warranty: For special warranty.
- 7 1.6 CLOSEOUT SUBMITTALS
- 8 A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
- 9 1. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME
10 A17.1/CSA B44.
- 11 B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for
12 normal, unrestricted elevator use.
- 13 C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form
14 of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State
15 services, obligations, conditions, and terms for agreement period and for future renewal options.
- 16 1.7 QUALITY ASSURANCE
- 17 A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by
18 manufacturer.
- 19 1.8 DELIVERY, STORAGE, AND HANDLING
- 20 A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store
21 materials, components, and equipment off of ground, under cover, and in a dry location.
- 22 1.9 COORDINATION
- 23 A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are
24 embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with
25 integral anchors, and installation instructions and deliver to Project site in time for installation.
- 26 B. Furnish well casing and coordinate delivery with related excavation work.
- 27 C. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators,
28 including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights,
29 and switches in hoistways, pits, and machine rooms.
- 30 1.10 WARRANTY
- 31 A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in
32 materials or workmanship within specified warranty period.

- 1 1. Failures include, but are not limited to, operation or control system failure, including excessive
- 2 malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of
- 3 materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and
- 4 similar unusual, unexpected, and unsatisfactory conditions.
- 5 2. Warranty Period: 1 year from date of Substantial Completion.

6 PART 2 - PRODUCTS

7 2.1 HYDRAULIC ELEVATOR MANUFACTURERS

- 8 A. Source Limitations: Obtain elevators from single manufacturer.

9 2.2 PERFORMANCE REQUIREMENTS

- 10 A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- 11 B. Accessibility Requirements: Comply with Section 407 in the United States Access Board's ADA-ABA Accessibility
- 12 Guidelines and with ICC A117.1.

13 2.3 ELEVATORS

- 14 A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers'
- 15 standard components shall be used, as included in standard elevator systems and as required for complete system.

16 B. Elevator Description:

- 17 1. Type: Under-the-car single cylinder.
- 18 2. Rated Load: 2000 lb (908 kg) or 2100 lb (953 kg).
- 19 3. Freight Loading Class for Service Elevators: Class A.
- 20 4. Rated Speed: 100 fpm (0.51 m/s).
- 21 5. Operation System: Single automatic operation.
- 22 6. Auxiliary Operations:
- 23 a. Standby-power operation.
- 24 b. Automatic operation of lights and ventilation fans.
- 25 c. Automatic Dispatching of Loaded Car
- 26
- 27
- 28 7. Car Enclosures:
- 29 a. Inside Width: 68 inches (1727 mm) from side wall to side wall.
- 30 b. Inside Depth: 51 inches (1295 mm) from back wall to front wall (return panels).
- 31 c. Inside Height: Not less than 93 inches (2362 mm) to underside of ceiling.
- 32 d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
- 33 e. Side and Rear Wall Panels: Enameled or powder-coated steel.
- 34 f. Reveals: Black.
- 35 g. Door Faces (Interior): Satin stainless steel, No. 4 finish.
- 36 h. Door Sills: Aluminum.
- 37 i. Ceiling: Luminous ceiling.
- 38 j. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish at sides and rear of car.
- 39 k. Floor: Refer to drawings for information.
- 40 l. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").

41 8. Hoistway Entrances:

- 1 a. Width: [36 inches (914 mm)] [42 inches (1067 mm)].
2 b. Height: 84 inches (2134 mm).
3 c. Type: Single-speed side sliding.
4 d. Frames: Satin stainless steel, No. 4 finish.
5 e. Doors: Satin stainless steel, No. 4 finish.
6 f. Sills: Aluminum.
- 7 9. Hall Fixtures: Satin stainless steel, No. 4 finish.
8 10. Additional Requirements:
- 9 a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin
10 stainless steel, No. 4 finish.
11 b. Provide hooks for protective pads in car and one complete set(s) of full-height protective pads.
12
- 13 C. Power supply:
14
15 1. 480 volt, 3-phase, 60 Hz.
- 16 2.4 SYSTEMS AND COMPONENTS
- 17 A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and
18 with minimum pulsations.
- 19 1. Pump shall be submersible type with submersible squirrel-cage induction motor, and shall be suspended
20 inside oil tank from vibration isolation mounts.
21 2. Motor shall have solid-state starting.
- 22 B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof
23 housing at pump unit.
- 24 C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to
25 minimize sound and vibration transmissions from power unit.
- 26 1. Cylinder units shall be connected with dielectric couplings.
27 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings
28 complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.
- 29 D. Hydraulic Fluid: Elevator manufacturer's standard fluid with additives as needed to prevent oxidation of fluid,
30 corrosion of cylinder and other components, and other adverse effects.
- 31 E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails,
32 machinery, and other components of elevator work. Device installation is specified in another Section.
- 33 F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to
34 provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Casing shall have
35 means of monitoring effectiveness to comply with ASME A17.1/CSA B44.
- 36 G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic
37 cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify
38 at temperatures below 60 deg F (16 deg C).
- 39 H. Car Frame and Platform: Welded steel units.
- 40 I. Guides: 6" spring tensioned roller guides or sliding guides with guide-rail lubricators. Provide guides at top and
41 bottom of car frame.

- 1 2.5 OPERATION SYSTEMS
- 2 A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of
3 operation indicated.
- 4 B. Auxiliary Operations:
- 5 1. Single-Car Standby-Power Operation: On activation of standby power, car is returned to a designated floor
6 and parked with doors open. Car can be manually put in service on standby power, either for return
7 operation or for regular operation, by switches in control panel located at main lobby. Manual operation
8 causes automatic operation to cease.
- 9 2. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start
10 closing.
- 11 3. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed,
12 lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car
13 doors open.
- 14 2.6 DOOR-REOPENING DEVICES
- 15 A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared
16 light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and
17 reopen.
- 18 B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating
19 door-reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.
- 20 2.7 CAR ENCLOSURES
- 21 A. General: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power
22 door operators, and ventilation.
- 23 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by
24 ASME A17.1/CSA B44.
- 25 B. Materials and Finishes: Manufacturer's standards, but not less than the following:
- 26 1. Subfloor: Exterior, underlayment-grade plywood, not less than **5/8-inch (15.9-mm)** nominal thickness.
- 27 2. Enameled- or Powder-Coated-Steel Wall Panels: Flush, formed-metal construction; fabricated from cold-
28 rolled steel sheet. Provide with factory-applied enamel or powder-coat finish; colors as selected by
29 Architect from manufacturer's full range.
- 30 3. Floor Finish: Refer to drawings for information.
- 31 4. Fabricate car with recesses and cutouts for signal equipment.
- 32 5. Fabricate car door frame integrally with front wall of car.
- 33 6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
- 34 7. Sight Guards: Provide sight guards on car doors.
- 35 8. Sills: Extruded or machined metal, with grooved surface, **1/4 inch (6.4 mm)** thick.
- 36 9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid
37 plastic.
- 38 10. Light Fixture Efficiency: Not less than 35 lumens/W.
- 39 11. Ventilation Fan Efficiency: Not less than **3.0 cfm/W (1.4 L/s per W)**.

- 1 2.8 HOISTWAY ENTRANCES
- 2 A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances
3 complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway
4 wall construction.
- 5 1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head
6 sections.
- 7 B. Fire-Rated Hoistway Entrance Assemblies: Door-and-frame assemblies shall comply with NFPA 80 and be listed and
8 labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-
9 to-neutral pressure as possible according to NFPA 252 or UL 10B.
- 10 1. Fire-Protection Rating: 1 hour.
- 11 C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
12
- 13 1. Stainless-Steel Frames: Formed from stainless-steel sheet.
14 2. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm)
15 high, on both jambs of hoistway door frames.
16 3. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
17 4. Sight Guards: Provide sight guards on doors matching door edges.
18 5. Sills: Extruded or machined metal, with grooved surface, 1/4 inch (6.4 mm) thick.
19 6. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying
20 with ASTM C 1107/C 1107M.
- 21 2.9 SIGNAL EQUIPMENT
- 22 A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled.
23 Provide buttons and lighted elements illuminated with LEDs.
- 24 B. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to
25 car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially
26 flush with face of return panel.
- 27 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
28 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted
29 adjacent to it, with text and graphics as required by authorities having jurisdiction.
- 30 C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials
31 preprogrammed number of monitoring station and does not require handset use. System is contained in flush-
32 mounted cabinet, with identification, instructions for use, and battery backup power supply.
- 33 D. Hall Push-Button Stations: Provide one hall push-button station at each landing.
- 34 1. Provide manufacturer's standard wall-mounted units.
35 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
- 36 E. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide the
37 following:
38
- 39 1. Units mounted in both car door jambs.
- 40 F. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals
41 sound once for up and twice for down.

- 1 1. At manufacturer's option, audible signals may be placed on cars.
- 2 G. Standby-Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated.
3 Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each
4 elevator, provide illuminated signals that indicate when they are operational and when they are at the designated
5 emergency return level with doors open.
- 6 H. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as
7 required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits
8 should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

9 2.10 FINISH MATERIALS

- 10 A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- 11 B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- 12 C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- 13 D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- 14 E. Aluminum Extrusions: **ASTM B 221** (**ASTM B 221M**), Alloy 6063.

15 PART 3 - EXECUTION

16 3.1 EXAMINATION

- 17 A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and
18 other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure
19 and other conditions under which elevator work is to be installed.
- 20 B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- 21 C. Proceed with installation only after unsatisfactory conditions have been corrected.

22 3.2 INSTALLATION

- 23 A. Excavation for Cylinder: Drill well hole in elevator pit to accommodate installation of cylinder; comply with
24 applicable requirements.
- 25 B. Provide waterproof well casing to retain well-hole walls.
- 26 C. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris
27 from well hole and provide permanent waterproof seal at bottom of well casing.
- 28 1. Fill void space between protective casing and cylinder with corrosion-protective filler.
- 29 D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place,
30 supported at pit floor. Seal between casing and pit floor with **4 inches (100 mm)** of nonshrink, nonmetallic grout.

- 1 E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place,
2 supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing
3 needed to maintain alignment and avoid overstressing guides.
- 4 F. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not
5 required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement
6 of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- 7 G. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration
8 transmission to structure and structure-borne noise due to elevator system.
- 9 H. Install piping above the floor, where possible. Install underground piping in casing.
- 10 1. Excavate for piping and backfill encased piping according to applicable requirements in Section 312000
11 "Earth Moving."
- 12 I. Lubricate operating parts of systems as recommended by manufacturers.
- 13 J. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate
14 alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft.
15 Reduce clearances to minimum, safe, workable dimension at each landing.
- 16 K. Leveling Tolerance: **1/4 inch (6 mm)**, up or down, regardless of load and travel direction.
- 17 L. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- 18 M. Locate hall signal equipment for elevators as follows unless otherwise indicated:
19
20 1. Mount hall lanterns at a minimum of **72 inches (1829 mm)** above finished floor.
- 21 3.3 FIELD QUALITY CONTROL
- 22 A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or
23 permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing
24 regulations and agencies.
- 25 B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be
26 performed on elevators.
- 27 3.4 DEMONSTRATION
- 28 A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).
- 29 B. Check operation of elevator with Owner's personnel present before date of Substantial Completion. Determine that
30 operation systems and devices are functioning properly.
- 31 END OF SECTION 142400

SECTION 21 05 00 - BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 21 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

- 1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.
- 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
- 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
- 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
- 5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

-
6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Burners.
 - b. Condensing Units.
 - c. Makeup Air Units.
 - d. Gas Trains.
 - e. Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

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2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
 3. Provides motor control and temperature control wiring, where so noted on the drawings.
 4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the HVAC Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

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3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.

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4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
 7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the fire protection work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these electronic files by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
21 05 00	Owner Training Agenda
21 13 00	Sprinkler Systems
21 13 00	Fire Protection Equipment

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number
- h. Notations of deviations from the contract documents
- i. Other pertinent data
- j. Provide space for Contractor's review stamps

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3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1.) Only approved manufacturers are used.
 - 2.) Addenda items have been incorporated.
 - 3.) Catalog numbers and options match those specified.
 - 4.) Performance data matches that specified.
 - 5.) Electrical characteristics and loads match those specified.
 - 6.) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7.) Dimensions and service clearances are suitable for the intended location.
 - 8.) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9.) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
 6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.

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- b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
 4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 21 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 21 XX XX.description.YYYYMMDD
 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

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- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
 - D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.8 WARRANTY

- A. Refer to Division 01 specification for requirements.

1.9 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.10 MATERIAL SUBSTITUTION

- A. Refer to Division 01 specification for requirements.

1.11 LEED REQUIREMENTS

- A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve this rating.
- B. Refer to Division 01 specification for additional requirements.

1.12 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Division 01 specifications, and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3 Enhanced Commissioning.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 specification for requirements.

3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract per specification 01 79 00.
- B. The instructions shall include:
1. Explanation of all system flow diagrams.
 2. Maintenance of equipment.
 3. Start-up procedures for all major equipment.
 4. Description of emergency system operation.
- C. Minimum hours of instruction for each item shall be:
1. Sprinkler System(s) - 1 hour.

3.4 SYSTEM COMMISSIONING

- A. The fire protection systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- C. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.5 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:
- Contractor shall maintain at the job site a separate and complete set of fire protection drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the fire protection systems.
- B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of other control devices, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

-
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.6 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.7 CONSTRUCTION WASTE MANAGEMENT

- A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).
 - 1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.
 - 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor's scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.
 - a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.
 - b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.
 - 3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION 21 05 00

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. Fire protection system operational.
3. Pipes labeled.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 21 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

- A. UL 723 - Surface Burning Characteristics of Building Materials
- B. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- C. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- D. Intertek / Warnock Hersey - Directory of Listed Products
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- F. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- G. Wisconsin Administrative Code
- H. 2009 International Building Code

1.4 SUBMITTALS

- A. Submit under provisions of Section 21 05 00.
- B. Submit Firestopping Installers Certification for all installers on the project.
- C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.
- D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.
 - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
 - 4. F and T ratings for each firestop system.
- E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

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- B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings:
 - a. Floor penetrations located outside wall cavities.
 - b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.
- F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

1.7 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 - 1. Review foreseeable methods related to firestopping work.
 - 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

- A. Provide one year warranty on parts and labor.

- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Products Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.
- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
 F Rating = Floor/Wall Rating
 T Rating = Floor/Wall Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999

<u>Penetrating Item</u>	<u>UL System No.</u>
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Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
F Rating = Wall Rating
T Rating = 0

<u>Penetrating Item</u>	<u>UL System No.</u>
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No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Floors) = Floor Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
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No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

- H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.
- I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

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- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
 - C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
 - D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the engineer and manufacturer's factory representative. The engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the engineer's discretion and the contractor's expense.

END OF SECTION 21 05 03

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SECTION 21 05 29 - FIRE SUPPRESSION SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 QUALITY ASSURANCE

- A. Support Sprinkler Piping in conformance with NFPA 13.
- B. Support Standpipes in conformance with NFPA 14.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"

Column #1: Steel pipe.

Column #2: Copper and plastic pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electroplated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:
 - 1. Parking Garage
 - 2. Sallyport
 - 3. Shower/Locker Rooms

2.2 PIPE HANGERS AND SUPPORTS

- A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).

- B. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes, but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed takeoff locations.

Acceptable Products:

Anvil - Fig. CT121
 Cooper/B-Line - Fig. B3373CT
 Erico - Model 510
 Nibco/Tolco - Fig. 82

- C. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

- D. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

Service: Bare Metal Pipe
 Rigid Plastic Pipe

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	Fig. CT65
Cooper/B-Line	Fig. 3100	Fig. B3104CT
Erico	Model 400	Model 402
Nibco/Tolco	Fig. 1	Fig. 81

2. Adjustable Swivel Ring Type:

Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	Fig. CT69
Cooper/B-Line	Fig. B3170NF	Fig. B170CT
Erico	Model FCN	
Nibco/Tolco	Fig. 200	Fig. 202

- E. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

- F. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
 Rigid Plastic Pipe

- a. Clamps in direct contact with copper pipe shall be plastic coated.

- b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

- G. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:

Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Inserts, Single Rod Galvanized:

Acceptable Products:

Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

3. Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:

Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

4. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

- H. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

I. Welding:

1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

C. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 PIPE SLEEVES AND LINTELS

- A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.

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- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
 - E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Engineer's design.
 - F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
 - G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
 - H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
 - I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.6 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes duct and pipe openings.

2.7 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.8 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.9 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 FIRE SUPPRESSION SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.
2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
2. Set all concrete inserts in place before pouring concrete.
3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
4. Piping shall not introduce strains or distortion to connected equipment.
5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.

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- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
 2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
 3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
 4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Installation of hangers shall conform to MSS SP-58 and applicable NFPA standards.	

END OF SECTION 21 05 29

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SECTION 21 05 53 - FIRE SUPPRESSION IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 21.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>O.D. of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- E. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- F. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.
- G. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape 6" wide by 3.5 mils thick, manufactured for direct burial, with aluminum foil core for location by non-ferric metal detectors and bold lettering identifying buried item.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 - 1. All valves (except shutoff valves at equipment) shall have numbered tags.

-
2. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 3. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 4. Number all tags and show the service of the pipe.
 5. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Tracer Wire:

1. Tracer wire shall be installed on top of all non-metallic buried utilities.
2. Tracer wire shall be taped directly to plastic water or drain pipe.
3. Tracer wire shall not be fastened directly or indirectly to gas piping.
4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all changes of direction.
5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.

6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. **Wire nuts shall not be used.**
8. The tracer wire shall daylight to grade through a 2" PVC conduit, at the point of the utility entrance to building. PVC conduit shall be capped and labeled as future contact point to locate the utility.

3.2 SCHEDULE

A. Pipes to be marked:

Pipe Service	Lettering Color	Background Color
Fire Protection Water	White	Red
Sprinkler Water	White	Red

- B. All piping downstream of the fire protection backflow preventer, upstream of sprinkler zone valves, shall be labeled Fire Protection Water. All piping downstream of sprinkler zone valves shall be labeled Sprinkler Water.

END OF SECTION 21 05 53

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SECTION 21 13 00 - FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe, Fittings, Valves, and Connections for Fire Protection System.
- B. Wet-Pipe Sprinkler System.

1.2 QUALITY ASSURANCE

- A. Welding Materials and Procedures: Conform to ASME Code.
- B. Equipment and Components: Bear UL label or marking.
- C. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body. Pressure rating shall match specified pipe system pressure rating. Remanufactured valves are not acceptable.
- D. Specialist Firm: Company specializing in sprinkler systems with minimum three years' experience.
- E. Sprinkler design drawings submitted by the Contractor shall be prepared by a NICET Water-Based Fire Protection Systems Layout Level III or Level IV designer or PE, and signed and sealed by a Professional Engineer licensed in the state where the project is located.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 21 05 00. Indicate pipe materials, joining methods, supports, floor and wall penetration seals, sprinklers, equipment data and ratings, and hydraulic calculations.
- B. Submit detailed pipe and sprinkler layout and other calculations and forms as described in NFPA 13.
- C. Submit detailed working drawings and obtain review of them in the following order:
 - 1. Engineer/Architect
 - 2. State Fire Marshal/Authority Having Jurisdiction
 - 3. Local Fire Department
 - 4. Owner's Insurance Company
 - 5. Architect/Engineer

Begin construction after all approvals are received.

- D. Working drawings shall include piping and sprinkler layout, sprinkler types and ratings, sections and elevations at critical points. Show coordination with lighting, ductwork, and diffusers, and indicate basic flow and hydraulic design information, including main location and date that the test was taken.
- E. Provide the Owner with one copy of NFPA 25. *Standard for the Inspection Testing and Maintenance of Water-based Fire Protection Systems.*

1.4 EXTRA STOCK

- A. Provide metal storage cabinet, wrenches for each sprinkler type, and extra sprinklers per NFPA 13 and applicable building code.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store valves and sprinklers in shipping containers, with labels in place.

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- B. Provide temporary protective coating on iron and steel valves.
 - C. Maintain temporary end caps and closures in place until installation.

1.6 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves to General Contractor for placement in walls and floors. Sleeve location to be determined by the Fire Protection Contractor prior to construction. If additional sleeves are required, they shall be core drilled by the Fire Protection Contractor.

1.7 SYSTEM DESCRIPTION

- A. System shall cover building areas noted.
- B. System shall interface with building fire alarm system. Provide all required wiring.
- C. Provide wet pipe sprinkler system to NFPA 13 and building code requirements as required by Owner's insurance company and as shown on the drawings.
- D. Provide a Fire Department connection.

1.8 REGULATORY REQUIREMENTS

- A. All material, equipment, and installation shall be approved by the Authorities Having Jurisdiction and the Owner's Insurance Company.
- B. The Authorities Having Jurisdiction and the Owner's Insurance Company shall have precedence over the drawings and specifications in case of discrepancies.
- C. The entire installation shall comply with all applicable codes.

1.9 SYSTEM DESIGN

- A. Design and install a complete, hydraulically calculated wet-pipe sprinkler system for the entire building.
- B. Provide all required equipment and accessories.
- C. System shall include a 5 psi allowance for future decrease in available pressure and an allowance for inside and outside hose streams.
- D. Provide monitor switches on all shutoff valves.
- E. Install sprinkler riser in location shown on drawings or as approved by the Architect/Engineer.
- F. Provide service shutoff valve in the sprinkler main with a wall indicator assembly.
- G. Provide pressure gauge with valve in the main riser.
- H. Provide main drain valve piped to outside the building. Locate so discharge does not damage lawn or other surfaces.
- I. Provide flow switch in the main riser and as indicated on drawings.
- J. Provide horn and strobe and all required wiring.

1.10 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 21 05 00 for required fire protection systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

1.11 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturers' operation and maintenance data. Include written maintenance data on components of system, servicing requirements, and record drawings.

1.12 JOB CONDITIONS

- A. Fire Protection Contractor shall determine the flow and pressure available at the service connection. The Fire Protection Contractor is responsible to verify this information and make all tests required. Base all pipe sizing and hydraulic calculations on flow test data no older than 18 months.
- B. Pipe sizing shown on drawings for service entrance and main risers is preliminary for coordination purposes only. Contractor is responsible for final sizing from hydraulic calculations.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Steel Pipe (Inside Building-Above Grade):

1. Pipe: 2" and Under - Schedule 40, black steel, ASTM A53. Threaded and coupled or flanged.
2. Joints: 2" and under - screwed or flanged.
3. Fittings: Screwed - cast iron, 125 lb., black, ANSI/ASME B16.4 or malleable iron, 150 lb., black, ANSI/ASME B16.3. Flanged-cast iron, 125 lb., ANSI/ASME B16.1.

B. Steel Pipe (Inside Building-Above Grade):

1. Pipe: 2-1/2" and Over - Schedule 10, black steel, grooved, ASTM A135.
2. Joints: Mechanically coupled grooved.
3. Fittings: 500 lb. WOG, black, malleable iron, ASTM A47.
4. Plain end fittings and couplings are not acceptable.

C. Fire Protection Service to Building (by others):

1. Refer to Section 22 10 00.

2.2 FLEXIBLE SPRINKLER HOSE WITH THREADED END FITTINGS

- A. UL listed per UL 2443.

2.3 UNIONS AND COUPLINGS

- A. Unions: 175 psi malleable iron for threaded ferrous piping.

B. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, designed to permit some angular and longitudinal deflection; "C" shaped composition sealing gasket, steel bolts, nuts, and washers. 175 psi, ASTM A47. Plain end fittings and couplings are not acceptable. Rolled groove couplings for Schedule 10 pipe. Cut groove couplings for Schedule 40 pipe. Couplings shall be enamel coated for wet systems. Acceptable Manufacturers: Victaulic, ITT, Grinnell, Central, Star Fittings.

C. Coupling gaskets for wet systems shall be Grade "E" EDPM Type A.

2.4 VALVE OPERATORS

A. Provide handwheels for gate valves. Provide gear operators for butterfly valves.

2.5 VALVE CONNECTIONS

A. Provide all connections to match pipe joints. Valves shall be same size as pipe.

2.6 BACKFLOW PREVENTERS

A. Provide backflow preventers as required by code and as specified on the drawings.

2.7 EQUIPMENT

A. Equipment shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION - PIPING

A. General Installation Requirements:

1. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over sprinkler piping and sprinklers.
2. Ream pipe and tube ends to full inside diameter. Remove burrs. Remove scale and foreign material, inside and outside, before assembly.
3. Die cut screw joints with full cut standard taper pipe threads.
4. Coat threads with pipe joint compound or wrap with Teflon tape.
5. Locate piping to minimize obstruction of other work.
6. Route piping in concealed spaces above finished ceiling.
7. Use full and double lengths of pipe wherever possible.
8. Slope all piping for complete drainage. Install auxiliary drains for all trapped piping per NFPA 13.
9. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
10. Comply with manufacturer's installation instructions.

B. Steel Piping:

1. In steel piping, main sized saddle branch connections or direct connection of branches to main is permitted if main is one pipe size larger than the branch for up to 6" mains and if main is two pipe sizes larger than branch for 8" and larger mains. Do not project branch pipes into main pipes.

C. Wall/Floor Penetration:

1. Provide sleeves when penetrating floors and walls.
2. Seal pipes passing through exterior walls with a wall seal per Section 21 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe. Sleeves through floors shall extend minimum 1.5" above finished floor.
3. Fire seal all pipe and sleeve penetrations (both wall and floor) to maintain fire separation required without restraining pipe.

D. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment. Fire protection equipment dedicated to the electrical equipment room or space may be installed above equipment if other alternatives are not available.

E. Hangers and Supports:

1. Provide hangers and supports as required by NFPA 13 and UL with the following exceptions:
 - a. Do not use powder driven devices, explosive devices, wooden plugs, or plastic inserts.
 - b. Do not install fasteners to carry the load in tension, unless absolutely necessary.

F. Exposed Piping:

1. Install chrome plated steel escutcheons where exposed pipes penetrate walls or floors.

3.2 INSTALLATION - VALVES

A. Install gate valves with stems upright or horizontal, not inverted.

B. Backflow Preventer:

1. Units shall be field tested and tagged in accordance with manufacturer's instructions by a certified tester before initial operation.
2. Install unit between 12" and 60" above finish floor.

C. Shutoff Valve:

1. Install buried shutoff valves in valve boxes. Provide post indicators.
2. Provide drain valves at main shutoff valves, low points of piping and apparatus.

3.3 INSTALLATION - EQUIPMENT

- A. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture locations shall have priority over system equipment and sprinklers.

B. Fire Department Connection:

1. Locate fire department connection in an accessible location as approved by the local fire department with sufficient clearance from walls, obstructions, and adjacent Siamese connectors to allow full swing of fire department wrench handle.

C. Horn and Strobe:

1. Locate outside horn and strobe on building wall as shown on drawings.
2. Wire all horn and strobes, flow switches and supervisory switches to fire alarm system. All wiring shall be in conduit and meet the requirements of the electrical specifications.

D. Test Valves:

1. Install test valves where required. Pipe to outdoors or drain. Test connection shall have flow equivalent to the smallest K-factor sprinkler.

E. Sprinklers:

1. Locate sprinklers to clear lights, ducts and diffusers. Do not run sprinkler pipes through ducts. Ductwork has priority over sprinkler pipes. Offset pipes as needed.
2. Center sprinklers in two directions in ceiling tiles and provide offsets as required.
3. Do not allow concealed sprinkler cover plates to be painted. Sprinkler cover plates are to be factory painted only. Do not field paint.
4. Apply strippable or paper covers so concealed sprinkler cover plates do not receive field paint finish.

3.4 SYSTEMS CLEANING AND TESTING

A. General Requirement:

1. All water used for testing and remaining in the piping system shall be obtained from a potable water source.

B. Underground Piping:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:
 - a. 390 gpm for 4" pipes.
 - b. 880 gpm for 6" pipes.
2. Branches from existing or new underground mains to sprinkler risers shall be flushed out through two 2-1/2" hoses (with flow through open hose butts) attached to the riser with 4" temporary piping. Flushing through the drain of an alarm check or dry pipe valve is not acceptable.

C. Interior Piping:

1. Verify adequate water flow at the inspector's test connection.
2. Flush all interior piping to remove scale and other foreign material before placing system into service.

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3. Hydrostatically test the entire interior piping system at a minimum of 200 psig or 50 psig in excess of the normal system working pressure for systems subjected to pressures in excess of 150 psig. Maintain test pressure for 2 hours without loss of pressure.

D. Fire Alarm System:

1. Test the alarm system by operating the inspector's test connection or the alarm test valves. Verify that the building fire alarm system activates.
2. Adjust all monitor switches for proper operation.

END OF SECTION 21 13 00

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SECTION 22 05 00 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

- 1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.
- 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
- 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
- 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
- 5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
- 6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

- 1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.

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2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
 3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Burners.
 - b. Condensing Units.
 - c. Makeup Air Units.
 - d. Gas Trains.
 - e. Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.3 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the HVAC Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.

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3. Coordination drawings are not shop drawings and shall not be submitted as such.
 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
 5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
 6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
 8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.4 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.

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2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.
- B. Qualifications:
1. Only products of reputable manufacturers are acceptable.
 2. All Contractors and subcontractors shall employ only workers skilled in their trades.
- C. Compliance with Codes, Laws, Ordinances:
1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
 2. Conform to all State Codes.
 3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
 4. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
 5. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
 6. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
 7. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
 8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- D. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
 2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
 3. Pay all charges for permits or licenses.
 4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
 7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for coordination drawings.

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7. The use of these electronic files by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
 8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.5 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals List:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
22 30 00	Water Softeners
Refer to drawings	Plumbing Material List Items

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number
- h. Notations of deviations from the contract documents
- i. Other pertinent data
- j. Provide space for Contractor's review stamps

3. Composition:

- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
- b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
- c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

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4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
 6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.

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10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 22 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 22 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.6 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.7 WARRANTY

- A. Refer to Division 01 specification for requirements.

1.8 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.9 MATERIAL SUBSTITUTION

- A. Refer to Division 01 specification for requirements.

1.10 LEED REQUIREMENTS

- A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve this rating.
- B. Refer to Division 01 specification for LEED credits being attempted on the project.

1.11 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Division 01 specifications, and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAac3 Enhanced Commissioning.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
 2. The Contractor shall do all excavating, filling, backfilling and compacting associated with his work.
- B. Excavation:
1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

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2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
 3. Trim bottom and sides of excavations to grades required for foundations.
 4. Protect excavations against frost and freezing.
 5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
 6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
 7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
 8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.
- C. Dewatering:
1. Contractor shall furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.
- D. Underground Obstructions:
1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
 2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.
- E. Fill and Backfilling:
1. Prior to backfilling all inspections and testing shall be completed.
 2. No rubbish or waste material is permitted for fill or backfill.
 3. Provide all necessary sand for backfilling.
 4. Dispose of the excess excavated earth as directed.
 5. Backfill materials shall be suitable for required compaction, clean and free of perishable materials and stones greater than 4 inches in diameter. Water shall not be permitted to rise in unbackfilled trenches. No material shall be used for backfilling that contains frozen earth, debris or earth with a high void content.
 6. Backfill all trenches and excavations immediately after installing pipes, or removal of forms, unless other protection is provided.
 7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.
 8. Lay all piping on a compacted bed of sand at least 3 inches deep. Backfill around pipes with sand, 6 inch layers, and compact each layer.

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9. Use sand for backfill up to grade for all piping under slabs or paved areas. All other piping shall have sand backfill to 6 inches above the top of the pipe.
 10. Place all backfill above the sand in uniform layers not exceeding 6 inches deep. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
 11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T-99 or ASTM D-698 test.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 specification for requirements.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract per specification 01 79 00.

B. The instructions shall include:

1. Explanation of all system flow diagrams.
2. Maintenance of equipment.
3. Start-up procedures for all major equipment.
4. Description of emergency system operation.

C. Minimum hours of instruction for each item shall be:

1. Domestic Hot Water System - 1 hour.
2. Water Softener System - 1 hour.

3.5 SYSTEM COMMISSIONING

- A. Refer to Division 01 91 00 specification for additional requirements.
- B. The plumbing systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.
- C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.

-
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of plumbing drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the plumbing systems.
- B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.7 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.8 CONSTRUCTION WASTE MANAGEMENT

- A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).
 - 1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.
 - 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor's scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.
 - a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the

General Contractor to establish the preferred calculation method and report the results accordingly.

b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION 22 05 00

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 22 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

- A. UL 723 - Surface Burning Characteristics of Building Materials
- B. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- C. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- D. Intertek / Warnock Hersey - Directory of Listed Products
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- F. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- G. Wisconsin Administrative Code

1.4 SUBMITTALS

- A. Submit under provisions of Section 22 05 00.
- B. Submit Firestopping Installers Certification for all installers on the project.
- C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.
- D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.
 - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
 - 4. F and T ratings for each firestop system.
- E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.

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- B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings:
 - a. Floor penetrations located outside wall cavities.
 - b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.
- F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

1.7 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 - 1. Review foreseeable methods related to firestopping work.
 - 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

- A. Provide one year warranty on parts and labor.

- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
 - 1. 3M; Fire Protection Produces Division.
 - 2. Hilti, Inc.
 - 3. RectorSeal Corporation, Metacaulk.
 - 4. Tremco; Sealant/Weatherproofing Division.
 - 5. Johns-Manville.
 - 6. Specified Technologies Inc. (S.T.I.)
 - 7. Spec Seal Firestop Products
 - 8. AD Firebarrier Protection Systems

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.
- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:
 - 1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
 F Rating = Floor/Wall Rating
 T Rating = Floor/Wall Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999

<u>Penetrating Item</u>	<u>UL System No.</u>
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Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
F Rating = Wall Rating
T Rating = 0

<u>Penetrating Item</u>	<u>UL System No.</u>
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No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
F Rating = Wall/Floor Rating
T Rating (Floors) = Floor Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
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No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

- H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.
- I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

-
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
 - C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
 - D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the engineer and manufacturer's factory representative. The engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the engineer's discretion and the contractor's expense.

END OF SECTION 22 05 03

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SECTION 22 05 29 - PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-1/2"	1/2"	1/2"
4" and 5"	5/8"	1/2"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"

Column #1: Cast iron pipe.
Column #2: Copper and plastic pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:
 - 1. Parking Garage
 - 2. Sallyport
 - 3. Shower/Locker Rooms

2.2 PIPE HANGERS AND SUPPORTS

- A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).
- B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
- C. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support at a depth not less than the specified insulation. Factory fabricated inserts may be used.

Acceptable Products:

- Anvil - Fig. 160, 161, 162, 163, 164, 165
- Cooper/B-Line - Fig. 3160, 3161, 3162, 3163, 3164, 3165
- Erico - Model 630, 631, 632, 633, 634, 635
- Nibco/Tolco - Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

- D. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.
- E. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

- Cooper/B-Line - Fig. B3380 through B3384
- Pipe Shields - A1000, A2000
- Erico - Model 124, 127

- F. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes (the Illinois Plumbing Code requires 10 foot maximum spacing for support of copper risers), but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs welded to the pipe. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed takeoff locations.

Acceptable Products:

- Anvil - Fig. CT121
- Cooper/B-Line - Fig. B3373CT
- Erico - Model 510
- Nibco/Tolco - Fig. 82

- G. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

- H. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

- I. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

- Service: Bare Metal Pipe
- Insulated Cold Pipe
- Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

2. Continuous Channel with Clevis Type:

- Service: Plastic Tubing
- Flexible Hose
- Soft Copper Tubing

Acceptable Products:

- Cooper/B-Line - Fig. B3106, with Fig. B3106V
- Erico - Model 104, with Model 104V
- Nibco/Tolco - Fig. 1V

3. Adjustable Swivel Ring Type:

Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

J. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

K. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches and smaller

- a. Clamps in direct contact with copper pipe shall be plastic coated.
- b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

L. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

3. Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:

Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

4. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-05. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

M. Copper piping located in an exposed area, including indirect waste piping in janitors closets, shall use split ring standoff hangers for copper tubing. Support shall have copper electroplating for corrosion resistance. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

Acceptable Products:

Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

N. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

O. Welding:

1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).

2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".

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3. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.
 4. Equipment requiring bases is as follows:
 - a. Water Heater
 - b. Water Softener
- C. Supports:
1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
 2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.
- D. Grout:
1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
 2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
 3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 ROOF PENETRATIONS

- A. Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.
- B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.6 PIPE SLEEVES AND LINTELS

- A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.

- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.
- J. Wall Seals ("Link-Seals"):
 - 1. Where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
 - 2. Sleeves, if used, shall be standard weight steel with primed finish and waterstop/anchor continuously welded to sleeve. If piping carries only fluids below 120°F, sleeves may be thermoplastic with integral water seal and textured surface.
 - 3. Sleeves shall be at least 2 pipe sizes larger than the pipes.
 - 4. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
 - 5. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40°F to 250°F
 - 6. Acceptable Manufacturers: Thunderline Corporation "Link-Seals", O-Z/Gedney Company, Calpico, Inc., Innerlynx, or Metraflex Company (cold service only).

2.7 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

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- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
 - C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- B. Supports Requirements:
 - 1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method of securing base to roof shall be compatible with roofing materials.
 - 2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
 - 3. Set all concrete inserts in place before pouring concrete.
 - 4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
 - 5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
 - 6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

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- C. Pipe Requirements:
1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
 2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
 3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
 4. Piping shall not introduce strains or distortion to connected equipment.
 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
 8. Provide at least one hanger adjacent to each joint in cast iron soil pipe, grooved end steel pipe with mechanical couplings, and glass pipe.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
 2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
 3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
 4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"
2.	Hard Drawn Copper & Brass (Liquid Service):	
	3/4" and under	5'-0"
	1"	6'-0"
	1-1/4"	7'-0"
	1-1/2"	8'-0"
	2"	8'-0"
	2-1/2"	9'-0"
	3"	10'-0"
	4"	12'-0"
	6"	12'-0"
3.	Cast Iron Soil Pipe - All Sizes:	
	Over 5' pipe lengths	10'-0"
	Less than 5' pipe lengths	5'-0"
	Support all direction changes and branch connections.	
4.	Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:	
	a. Continuous channel with hangers maximum 8'-0" O.C.	
5.	Rigid Plastic Pipe:	
	a. Space hangers at 4'-0" maximum centers.	
6.	Installation of hangers shall conform to MSS SP-58 and the applicable Plumbing Code.	

END OF SECTION 22 05 29

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SECTION 22 05 53 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 22.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>O.D. of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
- D. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- E. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- F. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 - 1. All valves (except shutoff valves at equipment) shall have numbered tags.

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2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 6. Number all tags and show the service of the pipe.
 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.
4. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

A. Pipes to be marked:

Pipe Service	Lettering Color	Background Color
Domestic Cold Water	White	Green
Domestic Hot Water - 115°F	Black	Yellow
Domestic Hot Water Circulating - 115°F	Black	Yellow
Sanitary Sewer	Black	Yellow
Vent	Black	Yellow
Storm Sewer (Primary and Secondary)	White	Green
Natural Gas	Black	Yellow
Tempered Water	Black	Yellow
Softened Cold Water	White	Green

END OF SECTION 22 05 53

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SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).
- C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).
- B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 3/4" thick per layer where multiple layers are specified.
- C. Type D: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

2.2 VAPOR BARRIER JACKETS

- A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

- A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum flame spread/smoke developed.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

A. General Installation Requirements:

1. Install materials per manufacturer's instructions, building codes and industry standards.
2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F), with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.
4. Neatly finish insulation at supports, protrusions, and interruptions.
5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3-1/2"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5" to 6"	18" long x 16 gauge
d.	8" to 14"	24" long x 14 gauge

7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.
8. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up to each stud.

B. Insulated Piping Operating Below 60°F:

1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, garages, chases at exterior walls, etc.), Type B insulation shall be used.

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3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- C. Insulated Piping Operating Between 60°F and 140°F:
1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.
- D. Exposed Piping:
1. Locate and cover seams in least visible locations.
 2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
 3. On exposed piping serving plumbing fixtures, the piping does not need to be insulated if less than four feet in developed length. If piping is longer than four feet in developed length, the piping shall be insulated and have a plastic jacket.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
2. Self-seal insulation may be used on pipes operating below 170°F.

C. Type D Insulation:

1. Use pre-molded half sections. Butt longitudinal and circumferential joints tightly. Wire in place with 16 gauge stainless steel wire on maximum 12" centers.
2. Apply in two layers. Stagger all joints between layers. Wire each layer individually.

3.4 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. Use plastic insulation covering on all exposed pipes including, but not limited to:
 - a. All exposed piping in areas noted on drawings.
 - b. All exposed piping in locker rooms.
 - c. All exposed piping below 8'-0" above floor.
 - d. All piping in mechanical rooms that are subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
 - e. All exposed piping in parking garage and sally port.

3.5 SCHEDULE

Piping System	Insulation Type/Thickness
A. Domestic Hot Water & Circulating - Potable and Non-Potable - up to 140°F	
Up to 1-1/2" Pipe Size	A / 1"
Above 1-1/2" Pipe Size	A / 1-1/2"
B. Domestic Cold Water - Potable and Non-Potable	B / 1"
C. Storm Drainage (include drain bodies and all piping within the building, except underground)	A / 1"
D. Plumbing Vents Within 10' from Roof Penetration	A / 1/2"
E. Insulation Inserts at hangers	D - Match pipe insulation thickness

END OF SECTION 22 07 19

SECTION 22 09 00 - INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pressure Gauge.
- B. Pressure Gauge Accessories.
- C. Thermometers.
- D. Test Plugs.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

- A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for water or oil application, 1/4" or 1/2" bottom connection. Gauges shall be 1% full scale accurate with bronze bushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.
- B. Acceptable Manufacturers: Ashcroft, Marsh, Marshalltown, Miljoco, Trerice, U.S. Gauge Figure 1901, Weiss, Weksler, Wika.
- C. Select gauge range for normal reading near center of gauge.

2.2 PRESSURE GAUGE ACCESSORIES

- A. All pressure gauges shall have valves and pressure snubbers.
- B. Shutoff Valve: 1/4" ball valve as specified for each piping system.
- C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.3 THERMOMETERS

- A. Dial Type:
 - 1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.
 - 2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.
 - 3. Stem lengths as required for application with minimum insertion of 2-1/2".
 - 4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Socket shall extend through insulation. Thermometers for air shall have an aluminum or brass duct flange.
 - 5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.

2.4 TEST PLUGS

- A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.

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- B. Provide extended units for all plugs installed in insulated piping.
 - C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.
 - D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install per manufacturer's instructions.
 - 2. Coil and conceal excess capillary on remote element instruments.
 - 3. Install gauges and thermometers in locations where they are easily read from normal operating level.
 - 4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.
- B. Positive Displacement Meters:
 - 1. Install positive displacement meters with shutoff valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Pressure Gauges:
 - 1. Connect pressure gauges to suction and discharge side of all pumps.
 - 2. Provide snubber for each pressure gauge.
 - 3. Provide coil syphon for each pressure gauge connected to steam piping.
- D. Thermometers:
 - 1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
 - 2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION 22 09 00

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Domestic Water Piping System.
- D. Sanitary Drainage and Vent Piping System.
- E. Storm Drainage Piping System.
- F. Footing Tile.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
- D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 COLD WATER - POTABLE AND NON-POTABLE
HOT WATER - POTABLE AND NON-POTABLE

- A. Design Pressure: 175 psi.
Maximum Design Temperature: 200°F.
- B. Piping - All Sizes:
 - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
 - 3. Fittings: Wrought copper solder joint, ANSI B16.22.
- C. Piping - 4" and Under (Contractor's Option):
 - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Mechanical press connection.

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3. Fittings: Copper, ANSI B-16.22, with embedded EPDM o-ring, NSF-61.
 4. Acceptable Manufacturers: Viega ProPress, Elkhart Xpress, Nibco Press System Fittings and Valving.

D. Shutoff Valves:

1. Ball Valves:

a. BA-1:

- 1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- a) Provide extended shaft for all valves in insulated piping.
- b) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

E. Throttling/Shutoff Valves:

1. Globe Valves:

- a. GL-1: 2" and under, 150# saturated steam, 300# CWP, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #3095, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, Nibco T-235Y.
- b. GL-2: 2-1/2" thru 10", 125# steam @ 353°F, 200# CWP @ 150°F, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #8906F, Milwaukee #F2981, Watts #F-501, Nibco F-718B.

F. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-5000, Nibco T-413B.
2. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA, Nibco w-920-W.

G. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi CWP @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777.
2. ST-7: 2-1/2" thru 8", bronze body, flanged ends, flanged cover, 150# steam, 225# CWP. Mueller Steam Specialty Co. #851.

2.2 COMBINATION WATER AND FIRE PROTECTION SERVICE
FIRE PROTECTION SERVICE

- A. Design Pressure: 200 psi.
Maximum Design Temperature: 150°F.
1. Pipe: Ductile iron pressure water pipe, ANSI/AWWA C151/A21.51, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4.
 2. Fittings: Ductile iron, ANSI/AWWA C110/A21.10, or ANSI/AWWA C153/A21.53, 200 psi pressure class, cement-mortar lined per ANSI/AWWA C104/A21.4, push-on joints.
 3. Joint: Push-on joint with rubber gasket, ANSI/AWWA C111/A21.11.
- B. PVC Pressure Pipe (Outside Building-Underground):
1. Pipe: PVC pressure pipe, Class 200 ANSI/AWWA C900 approved, bell and spigot ends.
 2. Joints: Push-On Type, elastomeric ring seal per ASTM F477, bevel spigot ends.
 3. Fittings: Cast iron bell and spigot type, 200 psig rating, corrosion protective coating outside, cement mortar lined inside, ANSI A21.10 or A21.11.

2.3 SANITARY DRAINAGE (ABOVE GROUND)
SANITARY INDIRECT DRAINAGE (ABOVE GROUND)
SANITARY VENT (ABOVE GROUND)
STORM DRAINAGE (ABOVE GROUND)
CONDENSATE DRAINAGE (ABOVE GROUND)

- A. Design Pressure: Gravity
Maximum Design Temperature: 180°F
- B. Piping - All Sizes:
1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and outside, ASTM A74, NSF Certified, CISPI Trademark.
 2. Joints: Compression gasket, ASTM C564 or lead and oakum, ASTM B29.
 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters. Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
- C. Piping within parking garage and Sallyport and piping within lower level locker/toilet rooms. All other piping outside this area shall be Cast Iron as noted above.
1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
 2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
 3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.
 4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.

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- 2.4 SANITARY DRAINAGE (BELOW GROUND - INSIDE BUILDING)
SANITARY VENT (BELOW GROUND - INSIDE BUILDING)
STORM DRAINAGE (BELOW GROUND - INSIDE BUILDING)
- A. Design Pressure: Gravity
Maximum Design Temperature: 180°F
- B. Piping - 1-1/4" through 16" (Maximum Design Temperature: 140°F):
1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends, conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
 2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
 3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends for Schedule 40 pipe.
 4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements or limitations.
- 2.5 SANITARY - PUMPED (BELOW GROUND)
STORM - PUMPED (BELOW GROUND)
- A. Piping - All Sizes:
1. Pipe: Schedule 40, rigid, unplasticized PVC, normal impact Type I, plain ends.
 2. Joints: Solvent-weld socket type with solvent as recommended by manufacturer.
 3. Fittings: Unplasticized PVC, normal impact Type I, solvent-weld socket type ends for Schedule 40 pipe. For connections to equipment, outlets and valves requiring screwed connections, use solvent socket to screwed joint PVC adapters or unions.
 4. Special Requirements: Schedule 40 PVC pipe.
- 2.6 SANITARY – PUMPED (ABOVE GROUND)
STORM - PUMPED (ABOVE GROUND)
- A. Piping - 4" and Under:
1. Pipe: Standard weight galvanized steel, threaded and coupled, ASTM A53.
 2. Joints: Screwed.
 3. Fittings: Galvanized cast iron screwed drainage type, ANSI B16.12, long radius.
- B. Shutoff Valves:
1. Ball Valves:
 - a. BA-1: 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze or brass body, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- 1) Provide extended shaft for all valves in insulated piping.
- 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2. Butterfly Valves:

a. BF-1:

- 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully lugged end, ductile or cast iron body (not in contact with fluid); bronze, aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff without backing flange or nuts and with cap screws extending to centerline of valve body (for pipe extension without draining system), 10 position locking operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200, Keystone #222, Watts #DBF-03-121-1P, Nibco N200 Series, Milwaukee CL series, Hammond 5200 series.

C. Check Valves:

1. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #B-5000, Nibco T-413-Y.
2. CK-13: 2-1/2" thru 12", 200# CWP, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961 EPDM or #WG-970 BUNA, NIBCO W-920-W, Crane.

2.7 FOOTING TILE

- A. Schedule 40 Perforated PVC Footing Tile - ASTM D1785/76 or DWV Perforated Footing Tile - ASTM D2665/76.
- B. Geotextile Fabric: As recommended by the manufacturer for this application. Acceptable Manufacturers: Typar, Cerex, Big 'O'.

2.8 UNIONS

- A. Copper pipe - wrought copper fitting - ground joint.
- B. Black Steel (Schedule 40) Pipe - malleable iron, ground joint, 150 psi, bronze to bronze seat.
- C. Galvanized Steel Pipe - galvanized malleable iron, ground joint, 150 psi, bronze to bronze seat.

2.9 AIR VENTS

- A. Provide means for venting air at all high points in the piping system and at all other points where air may be trapped.
- B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.

2.10 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 10"	12" - 18"
air	1/32"	3/64"	1/16"
water	3/64"	1/16"	1/8"

- B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.11 RELIEF VALVES

- A. RV-4: (Domestic Hot Water) Pressure and Temperature relief, cast bronze body and internal parts, stainless steel spring, test lever, threaded inlet and outlet. Maximum setting of 150 psi and 210°F temperature. Capacities ASME certified and labeled. Acceptable Manufacturers: Cash Series FV, Watts #40, #120, #N240, #340.

2.12 BALANCING VALVE

- A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with molded, removable insulation covers.

2.13 DRAIN VALVES

- A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread outlet and cap.

2.14 CONNECTIONS BETWEEN DISSIMILAR METALS

- A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between the connected metals, and that either allow no metal path for electron transfer or that provide a wide water gap lined with a non-conductive material to impede electron transfer through the water path.
- B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are used, including testing procedure.
- C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation from each other with the following exceptions:
1. Iron, steel, and stainless steel connected to each other.
 2. Brass, copper, and bronze connected to each other.
 3. Brass or bronze valves and specialties connected to steel, iron, or stainless steel in closed systems. Where two brass or bronze items occur together, they shall be connected with brass nipples.
- D. Dielectric protection is required at connections to equipment of a material different than the piping.
- E. Screwed Joints (acceptable up to 2" size):
1. Dielectric waterway rated for 300 psi CWP and 225°F.

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2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407, Matco-Norca.
- F. Flanged Joints (any size):
1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the bolts.
 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers minimum 1/8" thick.
 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths and installed carefully so the sleeves must extend partially past each steel washer when tightened.
 6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or Calpico.

2.15 LOCK OUT TRIM

- A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic water piping over 120°F, in compressed air piping, and as indicated on the drawings.

2.16 VALVE OPERATORS

- A. Provide handwheels for gate valves and gear operators for butterfly valves.

2.17 VALVE CONNECTIONS

- A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Connect to equipment with flanges or unions.
- E. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for piping that receives boiler blowdown.

3.2 TESTING PIPING

- A. Sanitary Drainage:
Sanitary Vent:
Storm Drainage:
 1. Test all piping with water to prove tight.

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2. Test piping before insulation is applied.
 3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
 4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
 5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.
 6. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.
 7. Submit signed documentation of pipe testing results within two weeks of completed test to A/E.

B. Hot Water - Potable and Non-Potable:
Cold Water - Potable and Non-Potable:
Service Water:

1. Test pipes underground or in chases and walls before piping is concealed.
2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.
3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen.
4. Hold test pressure for at least 2 hours.
5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.

C. Fire Service:

1. Hydrostatically test the entire system for two hours at 200 psig. Maximum leakage shall be:
 - a. Interior Piping: 0 quarts per hour.
 - b. Underground Piping: 0 quarts per hour.

D. All Other Piping:

1. Test piping at 150% of normal operating pressure.
2. Piping shall hold this pressure for one hour with no drop in pressure.
3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
4. Drain and clean all piping after testing is complete.

3.3 CLEANING PIPING

A. Assembly:

1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.

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2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing.
 3. Notify the Architect/Engineer's representative before starting any post erection cleaning in sufficient time to allow witnessing the operation. Consult with and obtain approval from the Architect/Engineer's representative with regard to specific procedures and scheduling. Dispose of cleaning and flushing fluids properly.
 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, and be certain all strainer screens are in place.
 5. Submit signed documentation of pipe cleaning results.
- B. All Water Piping:
1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
 2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
 3. If necessary, remove valves to clean out all foreign material.
- C. Fire Service:
1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:
 - a. 390 gpm for 4" pipes.
 - b. 880 gpm for 6" pipes.
 - c. 1560 gpm for 8" pipes.

3.4 INSTALLATION

- A. General Installation Requirements:
1. Provide dielectric connections between dissimilar metals.
 2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
 3. Group piping whenever practical at common elevations.
 4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
 5. Slope water piping and arrange to drain at low points.
 6. Install bell and spigot piping with bells upstream.
 7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
 8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
 9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
 10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted.

B. Installation Requirements In Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Valves/Fittings and Accessories:

1. Provide clearance for installation of insulation and access to valves and fittings.
2. Provide access doors for concealed valves and fittings.
3. Install valve stems upright or horizontal, not inverted.
4. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
5. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.
6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

D. Underground Piping:

1. Install buried water piping outside the building with at least 5 feet of cover.
2. Underground fire protection service piping shall have at least 6-1/2 feet of cover, or as recommended by NFPA 24, whichever is greater.
3. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.
4. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.
5. Lay all underground piping in trenches. Provide and operate pumping equipment to keep trenches free of water.
6. For all underground piping, provide a foundation (the layer below the bedding) if the trench bottom is unstable. Lay underground plastic piping on 4" to 6" of sand bedding. When the trench is in rock, lay underground metallic piping on 6" of sand bedding. Provide recessed areas for pipe bells and joints. After joints are made, any misalignment in elevation shall be corrected by tamping sand around the pipe. Backfill with sand in uniform layers not over 6" deep to the spring line of all underground pipes, and carefully compact each layer to 90 percent Standard Proctor density. Backfill with sand up to 6" above pipe for landscaped areas. Remaining backfill may be soil. Under paving and buildings, the remaining backfill shall be sand and compacted to 98 percent Standard Proctor density.
7. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.
8. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

E. Sanitary and Storm Piping:

1. Install all sanitary piping inside the building with a slope of at least the following:

<u>Pipe Size</u>	<u>Minimum Slope</u>
2"	0.25" per foot
3" and above	0.125" per foot

2. Install all storm piping inside the building with a slope of at least 0.125" per foot unless noted otherwise.
3. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
4. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 3 feet per second.
5. All sanitary piping shall have at least 48" of cover when leaving the building.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.
- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as possible.

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- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle from the horizontal plane for air lines, and from top, bottom or side for liquids.
 - N. Do not use geotextile fabric with footing tile if silt content of soil exceeds 40% or if clay content exceeds 50%. The fabric shall be installed around 1" river rock or 2" limestone.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- D. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.
- E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- H. All vent and drain piping shall be of same materials and construction for the service involved.

3.7 PLUMBING VENTS

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.
- C. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- D. In no case shall the vent through the roof be less than 4" in diameter.
- E. Vent pipes through the roof shall be located a minimum of 15 feet from any air intake or exhaust opening on the roof.

3.8 BRANCH CONNECTIONS

- A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.

D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:

1. Domestic water piping above grade.

E. Further limit use of mechanically formed fittings as follows:

1. Must have at least same pressure rating as the main.
2. Main must be type K or L copper tubing.
3. Permanent marking shall indicate insertion depth and orientation.
4. Branch pipe shall conform to the inner curve of the piping main.
5. Main must be 1" or larger.
6. Branch must be 3/4" or larger.

F. Branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

G. Forged weld-on fittings are limited as follows:

1. Must have at least same pressure rating as the main.
2. Main must be 2-1/2" or larger.
3. Branch line is at least two pipe sizes under main size.

3.9 JOINING OF PIPE

A. Threaded Joints:

1. Threads shall conform to ANSI B2.1 "Pipe Threads".
2. Ream pipe ends and remove all burrs and chips formed in cutting and threading.
3. Protect plated pipe and valve bodies from wrench marks when making up joints.
4. Apply thread lubricant to male threads as follows:

Vents and Roof Conductors:	Red graphite
All Other Services:	Teflon tape

B. Flanged Joints:

1. Steel pipe flanges shall conform to ANSI B16.5 "Steel Pipe Flanges and Flanged Fittings". Cast iron pipe flanges shall conform to ANSI B16.1 "Cast Iron Flanged and Flanged Fittings". Steel flanges shall be raised face except when bolted to flat face cast iron flange.
2. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
3. Set flange bolts beyond finger tightness with a torque wrench for equal tension in all bolts. Tighten bolts so those 180° apart are torqued in sequence.
4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.

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- c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water systems operating 140°F and less.
- C. Solder Joints:
- 1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
 - 2. Flux shall be non-acid type.
 - 3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable for 470°F.
- D. Welded Joints:
- 1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless mandatory local codes take precedence.
 - 2. Furnish to the Owner's Representative prior to start of work certificates qualifying each welder.
 - 3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
 - 4. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
 - 5. Backing rings shall be used for all butt weld joints 3" size and over, and for all sizes where operating pressure is over 200 psig and/or temperature is over 400°F. Backing rings shall be of the material being welded.
- E. Mechanical Joints:
- 1. Joints shall conform to ANSI A21.11 "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings". Gasket material shall be neoprene. The standard bolts and nuts of the pipe manufacturer shall be used and shall be coated at the factory with rust preventive lubricant after threading and tapping.
 - 2. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
- F. Solvent Weld Joints (PVC):
- 1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement conforming to ASTM D2564.
- G. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):
- 1. Gasket shall be heavy weight class, conforming to ASTM C564.
 - 2. The gasket shall have an internal center stop.

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3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel bands per fitting/joint.
 4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Provide necessary connections at the start of individual sections of mains for adding chlorine.
- B. Before starting work, verify system is complete, flushed and clean.
- C. Ensure pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.
- F. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main.
- G. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout entire building, including the last fixture connected to each main and each branch extending over 50 feet from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the entire system and repeat disinfection and testing procedure.
- H. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0 mg/L.
- I. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

3.11 SERVICE CONNECTIONS

- A. Provide new sanitary and/or storm sewer services. Before commencing work check invert elevations needed for sewer connections, confirm inverts and verify these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service with water meter with bypass valves. Provide sleeve in wall for service main per Section 22 05 29.

END OF SECTION 22 10 00

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SECTION 22 10 23 - NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Natural Gas Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.
- C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 22 05 00 for the required natural gas piping system electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 NATURAL GAS (0 TO 125 PSI)

- A. Design Pressure: 125 psi.
Maximum Design Temperature: 350°F
- B. Piping - 2" and Under:
 - 1. Pipe: Standard weight steel, threaded and coupled, ASTM A53.
 - 2. Joints: Screwed. (NOTE: For below ground, all sizes to have welded joints.)
 - 3. Fittings: 150# steam - 300# CWP, black malleable iron, banded, ASTM A197, ANSI B16.3.
 - 4. Unions: 250# - 500# CWP, black malleable iron, ANSI B16.39, ground joint with brass seat.
- C. Piping - 2-1/2" and Over:
 - 1. Pipe: Standard weight black steel, beveled ends, ASTM A53.
 - 2. Joints: Butt welded and flanged.
 - 3. Fittings: Standard weight seamless steel, butt weld type, ASTM A234, Grade I, ANSI B16.9.

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4. Flanges: 150# forged steel, weld neck or slip-on, ASTM A181, Grade I, ANSI B16.5.
- D. Shutoff Valves/Throttling Valves:
1. BA-13: 2" and under, threaded 600 psi CWP; UL listed for 250# LP, flammable liquid, heating oil, natural and manufactured gases, 150 psi steam, bronze body and chrome plated brass ball, Teflon seats and packing. Apollo #80-100, Nibco #T580-70-UL or #T585-70-UL, Watts #B-6000.
 2. PL-1: 2" and under, 125# steam @ 450°F, 175# CWP @ 180°F, cast iron body, screwed, full port. Walworth #1700, DeZurik #425, S-RS49.
 3. PL-2: 2-1/2" thru 4", 125# steam @ 450°F, 175# CWP @ 180°F, flanged, cast iron body, full port. Walworth #1700F, DeZurik #425, F-RS49.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Connect to all equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

- A. Low Pressure - Up to 1 psi:
 1. Test piping with 20 psi air pressure. System must hold this pressure without adding air for two hours.
- B. High Pressure - Above 1 psi:
 1. Test piping with compressed air at twice the operating gas pressure, but at least 20 psi. System must hold this pressure without adding air for two hours.
- C. A non-combustible odorant, such as oil of wintergreen, may be added to help locate leaks.

3.3 CLEANING PIPING

- A. Assembly:
 1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
 2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
 3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.

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4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

3.4 INSTALLATION

- A. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
- B. Install piping to conserve building space, and not interfere with other work.
- C. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Install thrust blocking and restraints on all buried piping at elbows and other changes in pipe direction.
- G. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
- H. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
- I. Provide clearance for access to valves and fittings.
- J. Provide access doors where valves are not exposed.
- K. Prepare pipe, fittings, supports, and accessories for finish painting.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
- N. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.
- O. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
- P. Provide flanges or unions at all final connections to equipment, traps and valves.
- Q. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
- R. All vertical pipe drops to equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted.
- S. Each above ground portion of a gas piping system, other than corrugated stainless steel tubing systems, that is likely to become energized shall be electrically continuous and bonded to an effective ground-fault current path. Gas piping, other than corrugated stainless steel tubing, shall be considered to be bonded

when it is connected to appliances that are connected to the appliance grounding conductor of the circuit supplying that appliance.

- T. Gas piping shall not be used as a grounding conductor or electrode.
- U. Where a lightning protection system is installed, the bonding of the gas piping shall be in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **All fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- F. Use full and double lengths of pipe wherever possible.
- G. Cut all pipe to exact measurement and install without springing or forcing.
- H. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage.
- B. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install gas pipes with bottom of pipe and eccentric reducers in a continuous line.
- C. Provide drip legs at low points and at the base of all risers in gas pipes. Drip legs shall be full line size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum length, capped with a reducer to a drain valve.

3.7 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

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- C. Use of forged weld-on fittings is also limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch line is at least two pipe sizes under header or main size.
 - D. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
 - E. All branch piping connections for natural gas shall take off on the top or on the side of the main.

3.8 JOINING OF PIPE

A. Threaded Joints:

- 1. Ream pipe ends and remove all burrs and chips.
- 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
- 3. Apply Teflon tape to male threads.

B. Flanged Joints:

- 1. Steel flanges shall be raised face.
- 2. Bolting for services up to 500°F shall be ASTM A307 Grade B with square head bolts and heavy hexagonal nuts conforming to ANSI B18.2.1 "Square and Hex Bolts" and B18.2.2 "Square and Hex Nuts".
- 3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
- 4. Gaskets for flat face flanges shall be full face type. Gaskets for raised faced flanges shall conform to requirements for "Group I Gaskets" in ANSI B16.5. Unless otherwise specified gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.
 - c. Minimum temperature rating: -10°F.

C. Welded Joints:

- 1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
- 2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
- 3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
- 4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
- 5. Backing rings shall be used for all butt weld joints 3" size and over, and for all sizes where operating pressure is over 200 psig and/or temperature is over 400°F. Backing rings shall be of the material being welded.

3.9 SERVICE CONNECTIONS

- A. Provide new gas service complete with gas meter and regulators. Verify gas service pressure with the Utility Company.

END OF SECTION 22 10 23

SECTION 22 10 30 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Roof and Floor Drains.
- B. Cleanouts.
- C. Traps.
- D. Water Hammer Arresters and Air Chambers.
- E. Backwater Valves

1.2 QUALITY ASSURANCE

- A. Manufacturer: For each product specified, provide components by same manufacturer throughout.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Provide cleanouts as shown and specified on the drawings as well as required by code.
- B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.
- C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.
- D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.2 TRAPS

- A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be:
 - 1. Chromium plated cast brass when used with plumbing fixtures or when installed exposed in finished spaces.
 - 2. Insulated at accessible lavatories.
 - 3. Cast iron, deep-seal pattern where concealed above ceiling, below grade or in unfinished areas.
 - 4. Deep-seal pattern of the same material and/or coating where drainage lines are of special materials or coatings such as polypropylene, PVDF, CPVC, etc.
- B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.
- C. Each trap shall be completely filled with water at the end of construction but before building space turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water and a 1/2" minimum layer of mineral oil.

2.3 TRAP SEALS AND PRIMERS

- A. Provide trap seals as specified on the drawings.

2.4 FLOOR DRAINS

- A. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

2.5 ROOF DRAINS

- A. Provide roof drains as shown and specified on the drawings as well as required by code.

2.6 WATER HAMMER ARRESTERS AND AIR CHAMBERS

- A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.
- B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100°F and 300°F and maximum 250 psig working pressure.
- C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12" long at fixtures and minimum 24" long on risers. Air chambers shall be the same size or larger than the piping it is connected to.

2.7 BACKWATER VALVES

- A. Provide backwater valves as shown on drawings as well as required by code.
- B. PVC body, PVC access cover, PVC flapper. Flapper to be in closed position during non-operation period.
- C. Backwater valve and flapper shall be extendable to the grade and be able to removed and replaced from grade with a sleeve and associated tools.
- D. Acceptable manufacturers: Rectorseal Clean Check.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

- A. Coordinate construction to receive drains at required invert elevations.
- B. Install all items per manufacturer's instructions.
- C. Water Hammer Arresters and Air Chambers:
 - 1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Engineer/Owner.
 - 2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.
 - 3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.
 - 4. Install air chambers at each fixture not protected by a water hammer arrester.

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- D. Cleanouts:
1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6" size and 75 feet apart in 6" and larger pipes inside the building.
 2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.
 3. Extend cleanouts to the floor with long sweep elbows.
 4. Install a full size, two-way cleanout within 5 feet of the foundation inside or outside of building.
 5. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.
 6. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12" above the finished floor.
- E. Floor Drains:
1. Drains in upper floors shall have a flashing of EPDM or similar membrane sheet. The sheet shall be at least 36" X 36" square with the drain in the center. Clamp membrane in auxiliary clamping ring of floor drain.
 2. Use alternate sealing method when installing drains in existing floor slabs.
 3. Coordinate sloping requirements with the architectural plans and specifications.
- F. Roof Drains:
1. Roof drains shall have bearing pans.
 2. Provide auxiliary support steel under drains as required to prevent movement of the drain.
 3. All roof drains shall have underdeck clamps.
 4. Drains in built-up roofing systems shall have a 36" x 36", 3 lb density lead sheet flashing.
- G. Backwater Valves
1. Set backwater valves on undisturbed soil or compacted granular backfill, level and plumb with top adjusted to finished floor elevation. Test and adjust valve for proper operation. Allow minimum 18" clearance for servicing.

END OF SECTION 22 10 30

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SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters.
- B. Water Softeners.

1.2 QUALITY ASSURANCE

- A. Products and installation of specified products shall conform to recommendations and requirements of the following organizations:
 - 1. American Gas Association (AGA).
 - 2. National Sanitation Foundation (NSF).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
 - 5. National Electrical Manufacturers' Association (NEMA).
 - 6. Underwriters' Laboratories (UL).

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 22 05 00.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. For equipment connected to an electric power source, submit short circuit rating (SCCR) of integrated unit.
- E. Submit manufacturer's installation instructions including control and wiring diagrams.
- F. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- G. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- H. Submit a current water analysis from the actual water source serving the project site for softening equipment verification before sending shop drawings to the Architect/Engineer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 REGULATORY REQUIREMENTS

- A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.
- B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.
- C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

2.1 WATER HEATERS

- A. All water heaters shall be as scheduled on the drawings.

2.2 COMMERCIAL WATER SOFTENER

- A. Automatic duplex water softener to remove hardness to no more than 1.0 grains per gallon as determined by an ASTM Standard Soap Test Method.
- B. Incoming water contains approximately 21 grains per gallon based on information obtained from the local utility. Obtain a current water sample from the water source that will be serving the project and have it analyzed to make sure equipment can perform as designed. Provide report to the Architect/Engineer before providing shop drawings.
- C. Refer to plumbing material list for requirements.
- D. Softener Tank: Fiberglass reinforced polyester, designed for a minimum working pressure of 100 psig, hydrostatically tested at 150% of working pressure. Sideshell height to allow a minimum freeboard space of 50% of the mineral bed depth for adequate expansion during backwashing. Tank bottom will be supported with a molded structural base. Tank shall have capacity to support at least 600 lbs of dry salt.
- E. Distribution System: Soft water collector and backwash distributor, hub and arm radial or healer lateral type lower distribution system. Distribution shall be covered with a single layer of washed inorganic media to evenly distribute the service and backwash water and support the mineral bed tank.
- F. Brine Tank: Rigid polyethylene or fiberglass with tight fitting cover. Corrosion-free elevated salt platform, float-operated plastic fitted brine valve to control brine withdrawal and freshwater refill. The brine valve shall provide positive shutoff to prevent air from entering the system. Brine eductor shall dilute brine flow to softener. Brine shall be provided with a float-operated shutoff valve to keep the tank from overfilling.
1. Provide initial fill of brine tank with manufacturer recommended salt product. Tank shall be full at time the Owner is given occupancy.
- G. Softener Ion Exchange Resin: Virgin, high capacity, standard mesh of sulfonated polystyrene type stable over the entire PH range, with good resistance to bead fracture from attrition or osmotic shock. Minimum exchange capacity of 30,000 grains when regenerated with 15 lbs. of salt per cubic foot. Solid resin, of the proper particle size of 20 to 50 mesh, U.S. standard screen, and will contain no agglomerates, shells, plates, or other shapes to interfere with normal function of water softener.
- H. Pipes, Valves and Fittings: Pipe shall be galvanized, standard weight steel, Type L copper, or Schedule 5 stainless steel. Fittings shall be 125 lb. Class malleable iron for steel, Type L for copper, and Schedule 5 for stainless steel. All piping shipped assembled shall be hydrostatically tested for leaks at the factory.
- I. Water Testing Equipment: Complete with sample cock installed to obtain samples of effluent water. Furnish a complete test kit for conducting soap tests.
- J. Automatic Controls:
1. The main control shall be a fully automatic, top-mounted brass control and sized with 2" inch NPT inlet and outlet connections. The top-mounted main control design will be motor driven, mechanically activated, with five pistons to accomplish the regeneration steps of backwash, brine draw/rinse, fast rinse, and brine refill, in addition to the service position.
2. The main control shall incorporate self-adjusting flow regulators to control the rate of flow and prevent resin loss during backwash, regardless of the system pressure fluctuations between 30 and 120 psig.

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3. Valves shall be controlled by integral electronic controls. Controls shall display status of each unit with respect to service and regeneration. Controls for multi-tank systems shall be capable of operating units simultaneously, alternating unit service, or progressively bringing additional units on and off line as needed to maintain flow rates and reduce risk of channeling.
 4. Regeneration shall be initiated by time and volume. System shall be programmed so units are unable to regenerate simultaneously.
 5. All control mechanisms shall be enclosed in a UL listed NEMA 3 enclosure. A fully integrated, programmable, microprocessor-driven electronic controller shall be provided to automatically cycle the main control through the regeneration sequence.
 6. Each controller shall be provided with dry contacts that will be able to send status signals to the building automation system.
 7. Electrical Requirements: Each valve shall be prewired with a plug and cord and an inline breaker to plug into a standard receptacle or wired to a common control panel so a single electrical connection can be provided. 120 volt-single phase. Electric power shall not be needed for manual regeneration. Inlet hydraulic pressure shall be required.
- K. Extra Stock:
1. Furnish extra materials as listed below that match products installed and that are packaged and labeled for storage.
 - a. Provide 100 lbs. additional salt in the same form as the original load. Salt shall be delivered and stored on pallet(s). Locate the pallet(s) per the Owner's direction.
- L. Warranty:
1. Provide a standard one-year warranty on the entire unit from the date of final acceptance.
 2. Provide a standard two-year warranty on the control valve internal parts, the brine valve and associated parts, and the salt storage container internal components.
 3. Provide a standard five-year warranty on the control valve body, fiberglass wound container(s) (if applicable), salt storage container(s) (if applicable), and epoxy lined steel conditioner tank(s) (if applicable).
- M. Acceptable Manufacturers: Capital Water Softener, Windsor Series or Hellenbrand High Efficiency Series.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases. Coordinate sizes and locations of concrete bases. Refer to Section 22 05 29.
- B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

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- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.
 - D. Install gas water heaters according to NFPA 54.
 - E. Provide two hours of instruction and orientation to the Owner's maintenance staff. System walk-through, including programming of any system controllers shall be included in training.

3.3 WATER SOFTENER INSTALLATION

- A. Verify connection sizes and piping type with cold water and soft cold water piping. Provide dielectric connection between dissimilar metals. Pressure gauges are required at hard water inlet and soft water outlet of each softener.
- B. Provide system start-up and subsequent service, with stocking of spare parts by authorized dealer or factory trained personnel.
- C. Provide complete instructions covering installation and operation of the softening system in booklet form. All components shall be easily identified, in exploded views, by individual part number.
- D. Provide two hours of instruction and orientation to the Owner's maintenance staff. System walk-through, including programming of any system controllers shall be included in training.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All plumbing fixtures.

1.2 SUBMITTALS

- A. Submit product data under provisions of Section 22 05 00. Submittals shall include fixture carriers for record purposes only. Architect/Engineer does not review or approve carriers except for manufacturer.
- B. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Wall Hung Fixture Carriers:
 - 1. Material: All Metal, ASME/ANSI A112.6.1M.
 - 2. Acceptable Manufacturers: Zurn, Smith, Wade, Josam, Watts, Mifab.
 - 3. Water closet carrier shall be rated to support 500 lbs. unless noted otherwise on the drawings.
- B. All fixtures shall be as scheduled on the drawings.
- C. All china shall be from the same manufacturer where possible.
- D. All lavatory and sink trim shall be from the same manufacturer where possible.
- E. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
 - 2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
 - 3. Provide fixtures with chrome plated rigid or flexible supplies, loose key stops, reducers, and escutcheons.
 - 4. Install components level and plumb.

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5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicon caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
 6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
 7. Refer to Plumbing Material List for fixture mounting heights.
 8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
- B. Wall-Mounted Fixture Requirements:
1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab.
- C. Floor-Mounted Fixture Requirements:
1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.
- D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:
1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.
 2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.
 3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.
 4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.
- E. ADA Lavatory Requirements:
1. All handicapped accessible lavatory traps, piping and angle stops shall be installed with an insulating kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.
- F. ADA Water Closet Requirements:
1. Handicapped accessible water closet flush valve handles shall face the center of the stall.
 2. Coordinate flush valves in handicap accessible locations with grab bars installed by the General Contractor. Make modifications required to flush valve after review by Architect/Engineer.
- G. Shower Requirements:
1. All acrylic and fiberglass showers shall have a non-shrink grout or manufacturer-approved material installed between the finished floor and floor of the fixture to prevent damage caused by deflection.

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2. All rough-in pockets for showers located in basement floor installations shall be filled in with concrete and sealed tight.

3.2 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

- A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION 22 40 00

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SECTION 23 05 00 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in the specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make his portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

A. Definitions:

- 1. "Mechanical Contractors" refers to the following:
 - a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.
- 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
- 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
- 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
- 5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

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6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Burners.
 - b. Condensing Units.
 - c. Makeup Air Units.
 - d. Gas Trains.
 - e. Package Air Handling Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Temperature Control Subcontractor's Responsibility:
 - a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Subcontractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.

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2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when so noted on the Electrical Drawings.
 3. Provides motor control and temperature control wiring, where so noted on the drawings.
 4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, hydronic piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the HVAC Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

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3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.

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4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
 7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's Laboratories, Inc.

E. Examination of Drawings:

1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pipes and ducts to best fit the layout of the job.
3. Scaling of the drawings is not sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
7. Determination of quantities of material and equipment required shall be made by the Contractor from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater number shall govern.
8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word "install" shall mean connect complete and ready for operation, and the word "provide" shall mean to supply for use and connect complete and ready for operation.
 - a. Any item listed as furnished shall also be installed, unless otherwise noted.
 - b. Any item listed as installed shall also be furnished, unless otherwise noted.

F. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any supports, pipes or ducts.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.

4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these electronic files by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
23 05 00	Owner Training Agenda
23 05 13	Motors
23 05 15	Variable Frequency Drives
23 05 48	HVAC Vibration Isolation
23 05 93	Testing, Adjusting, and Balancing
23 09 00	Controls
23 21 23	HVAC Pumps
23 25 00	Chemical Treatment Systems
23 33 00	Fire Dampers
23 33 00	Combination Fire Smoke Dampers
23 34 13	Axial Fans
23 34 16	Centrifugal Fans
23 36 00	Terminal Air Boxes
23 37 00	Grilles, Registers, and Diffusers
23 37 00	Louvers
23 52 16	Condensing Boilers
23 62 13	Air Cooled Condensing Units
23 72 00	Energy Recovery Devices
23 73 13	Indoor Modular Air Handling Units
23 74 23.13	Gas Fired Make-Up Air Units
23 82 00	Terminal Heat Transfer Equipment
23 82 16	Coils

- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number

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- f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
- a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.

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- 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.

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4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 23 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 23 XX XX.description.YYYYMMDD
 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.7 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
 1. Air Cooled Condensers
 2. Inline Pumps
 3. Boilers, Burners and Boiler Trim
 4. Condensing Units
 5. Gas Fired Makeup Air Units
 6. Air Handling Units
 7. Energy Recovery Units
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.9 WARRANTY

- A. Refer to Division 01 specification for requirements.

1.10 MATERIAL SUBSTITUTION

- A. Refer to Division 01 specification for requirements.

1.11 LEED REQUIREMENTS

- A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve this rating.
- B. Refer to Division 01 specification for requirements.

1.12 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00, and provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3 Enhanced Commissioning.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 specification for requirements.

3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract per specification 01 79 00.
- B. The instructions shall include:
 - 1. Explanation of all system flow diagrams.
 - 2. Explanation of all air handling systems.
 - 3. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
 - 4. Maintenance of equipment.
 - 5. Start-up procedures for all major equipment.
 - 6. Explanation of seasonal system changes.
 - 7. Description of emergency system operation.
- C. Minimum hours of instruction for each item shall be:
 - 1. Heating Water System - 4 hours.

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2. Refrigeration System - 2 hours.
 3. Chemical Treatment System - As defined in Section 23 25 00.
 4. Air Handling System(s) - 2 hours.
 5. Temperature Controls - As defined in Section 23 09 00.

3.4 SYSTEM COMMISSIONING

- A. Refer to specification 01 91 00 for additional requirements.
- B. The mechanical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.
- D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.5 RECORD DOCUMENTS

- A. The following paragraph supplements Division 1 requirements:

Contractor shall maintain at the job site a separate and complete set of mechanical drawings and specifications on which he shall clearly and permanently mark in complete detail all changes made to the mechanical systems.
- B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.
- D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- F. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.6 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.7 CONSTRUCTION WASTE MANAGEMENT

- A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).
 - 1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.
 - 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor's scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.
 - a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.
 - b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.
 - 3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION 23 05 00

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READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. All air handling units operating and balanced.
2. All fans shall be operating and balanced.
3. All pumps, boilers operating and balanced.
4. All miscellaneous mechanical systems (unit heaters, fan coil units, cabinet heaters, etc.) operating.
5. All temperature control systems operating, programmed and calibrated.
6. Pipe insulation complete, pipes labeled and valves tagged.
7. Fire damper and fire/smoke damper access doors labeled in accordance with specifications.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 23 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

- A. UL 723 - Surface Burning Characteristics of Building Materials
- B. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- C. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- D. Intertek / Warnock Hersey - Directory of Listed Products
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- F. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- G. Wisconsin Administrative Code

1.4 SUBMITTALS

- A. Submit under provisions of Section 23 05 00.
- B. Submit Firestopping Installers Certification for all installers on the project.
- C. Shop Drawings: Submit for each condition requiring firestopping. Include descriptions of the specific penetrating item, actual wall/floor construction, manufacturer's installation instructions, and UL or Intertek / Warnock Hersey Assembly number.
- D. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.
 - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
 - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
 - 4. F and T ratings for each firestop system.
- E. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- B. Install material prior to expiration of product shelf life.

1.6 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings:
 - a. Floor penetrations located outside wall cavities.
 - b. Floor penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.
- F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

1.7 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 - 1. Review foreseeable methods related to firestopping work.
 - 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.8 WARRANTY

- A. Provide one year warranty on parts and labor.

- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.

1. 3M; Fire Protection Produces Division.
2. Hilti, Inc.
3. RectorSeal Corporation, Metacaulk.
4. Tremco; Sealant/Weatherproofing Division.
5. Johns-Manville.
6. Specified Technologies Inc. (S.T.I.)
7. Spec Seal Firestop Products
8. AD Firebarrier Protection Systems

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.
- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
 F Rating = Floor/Wall Rating
 T Rating = Floor/Wall Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999

<u>Penetrating Item</u>	<u>UL System No.</u>
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
 F Rating = Wall Rating
 T Rating = 0

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
 F Rating = Wall/Floor Rating
 T Rating (Floors) = Floor Rating

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

- H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.
- I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.

-
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
 - C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
 - D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION 23 05 03

SECTION 23 05 13 - MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00. Include nominal efficiency and power factor for all premium efficiency motors. Efficiencies must meet or exceed the nominal energy efficiency levels presented below.
- B. Submit shop drawings for all three phase motors.
- C. Submit motor data with equipment when motor is installed by the manufacturer at the factory.
- D. Submit shaft grounding device for all motors as required.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in the manufacture of commercial and industrial motors and accessories, with a minimum of three years documented manufacturing experience.

PART 2 - PRODUCTS

2.1 MOTORS - GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Refer to the drawings for required electrical characteristics.
- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.

- F. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.
- G. Each contractor shall set all motors furnished by him.
- H. All motors shall have a minimum service factor of 1.15.
- I. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- J. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.
- K. Aluminum end housings are not permitted on motors 15 HP or larger.
- L. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.

2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)

- A. All motors, unless exempted by EAct legislation that became federal law on December 19, 2010, shall comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall also be at least the following:

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7
40.0	94.1	94.1	92.4	94.1	94.1	92.4

- B. Motor nameplate shall be noted with the above ratings.

2.3 MOTORS ON VARIABLE FREQUENCY DRIVES

- A. All motors driven by VFDs shall be premium efficiency type.
- B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors shall not be equipped with auxiliary blowers.

-
- C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors.

 - A. All 460 volt motors controlled by VFDs shall be equipped with an alternate discharge path, such as a shaft grounding ring or grounding brush, to divert adverse shaft currents from the motor bearings on the drive end of the motor shaft. Motor shafts 2" and larger require shaft grounding on the drive end and the non-drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.
 - 1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the motor is affixed with a label clearly indicating the presence of a grounding assembly. The grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the drive endplate.

2.4 MOTOR DRIVEN EQUIPMENT

- A. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.

- B. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.

2.5 SHEAVES

- A. All sheaves shall conform to NEMA Standard MG1-14.42, which lists minimum diameters and maximum overhangs. Locate motors to minimize overhang.

- B. When replacing sheaves, use sheaves of at least the originally supplied sizes.

- C. Contractor responsible for motor shall also be responsible for replacement sheaves. Coordinate with testing and balancing of the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

- B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.

END OF SECTION 23 05 13

SECTION 23 05 15 - VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable frequency drives

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Variable Frequency Drive Schedule for rating and configuration.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
- C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
- E. Provide harmonic distortion analysis of total service to prove variable frequency drives proposed do not exceed the latest version of IEEE 519 voltage and current distortion limits as shown in Table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary side of the main distribution transformer.

1.4 EXTRA MATERIAL

- A. Furnish under provisions of Section 26 05 00.
- B. Provide two of each air filter.
- C. Provide three of each fuse size and type.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 26 05 00.
- B. Accept controllers on site in original packing. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Maintenance Data: Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

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- C. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
 - D. Shop Drawings: For each VFD.
 - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Nameplate legends.
 - c. Short-circuit current rating of integrated unit.
 - d. UL listing for series rating of overcurrent protective devices in combination controllers.
 - e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
 - 2. Wiring Diagrams: Power, signal, and control wiring for VFDs. Provide schematic wiring diagram for each type of VFD.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS: DANFOSS

2.2 DESCRIPTION

- A. Converts 60 Hertz input power at voltage specified to a variable AC frequency and voltage for controlling the speed of AC squirrel cage motors. The controller shall be suitable for use with standard NEMA B squirrel cage 1.15 service factor induction motors without requiring any modifications to the motor or the drive.
- B. Controller shall have sufficient capacity to provide speed control of the motors shown or noted throughout the specified environmental operating conditions.
- C. Controller shall have the functional components listed below:
 - 1. Door interlocked input circuit breaker/fused switch.
 - 2. Input rectifier section to supply fixed DC bus voltage.
 - 3. Smoothing reactor for DC bus.
 - 4. DC bus capacitors.
 - 5. Control transformer.
 - 6. Separate terminal blocks for power and control wiring.
 - 7. Terminal block for operator controls.
 - 8. Sine weighted PWM generating inverter section.

2.3 RATINGS

- A. Rated Input Voltage: Refer to mechanical equipment schedule for motor requirements.
- B. Motor Nameplate (Drive Output) Voltage: Refer to Mechanical Schedules.
- C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
- D. Operating Ambient: 0°C to 40°C.
- E. Minimum Relative Humidity Range: 5% to 90% (non-condensing).

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- F. Minimum Elevation without Derating: 3300 feet.
 - G. Minimum Efficiency at Full Load: 96 percent.
 - H. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds or 180% for 0.5 seconds.
 - I. Starting Torque: 100 percent of rated torque or as indicated.
 - J. Speed Regulation: Plus or minus 1 percent with no motor derating.

2.4 DESIGN

- A. Pulse Width Modulated (PWM) Variable Frequency Drives:
 - 1. Converter shall be of a diode bridge design with a sine-weighted PWM inverter section.
 - 2. Main semi-conductors in the inverter section of controller shall be IGBT transistors capable of a carrier switching frequency of up to 8 kHz. If derating of the inverter is necessary to run at 8kHz, then the unit's derated currents must equal or exceed the motor full load currents listed in NEC Table 430-150.
 - 3. All controllers supplied with semi-conductors capable of switching at less than 8,000 Hertz shall be supplied with a motor acoustic noise reduction filter.
 - 4. Pulse width modulated (PWM) drives shall be supplied with drive input line reactors with a minimum impedance of 3%. Reactors shall be installed to filter entire drive input circuit.
 - 5. Pulse width modulated (PWM) drives shall be supplied with drive input harmonic filter to reduce the total harmonic distortion to less than the IEEE519-1992 limits at the utility service entrance.
 - 6. Drives that are located beyond the manufacturer's recommended maximum distance from the motor shall be provided with dV/dt (long lead) filters.
- B. All drives shall have built-in diagnostic capability with status and fault indicators mounted on enclosure door. Complete operating instructions for diagnostics shall be mounted inside of the enclosure door.
- C. Drive shall restart after power loss and under-voltage fault. The minimum number of restart attempts required shall be three, field adjustable.
- D. The drive shall allow unlimited switching of the output without damage to the drive or motor.

2.5 PRODUCT FEATURES

- A. Display: Provide integral digital display to indicate all protection faults and drive status (including overcurrent, overvoltage, undervoltage, ground fault, overtemperature, phase loss, input power ON, output voltage, output frequency, and output current.
- B. Protection:
 - 1. Input transient protection by means of surge suppressors.
 - 2. Snubber networks to protect against malfunctions due to system transients,
 - 3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.

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4. Motor thermal overload relay(s) adjustable and capable of NEMA Class 20 motor protection and sized per motor nameplate data. When multiple motors are connected to the VFD output, each motor shall have a manual starter with properly sized overload protection.
 5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 6. Instantaneous line-to-line and line-to-ground overcurrent trips on input and output.
 7. Loss-of-phase protection.
 8. Reverse-phase protection.
 9. Short-circuit protection (fuses or circuit breaker).
 10. Motor overtemperature fault.
- C. Acceleration Rate Adjustment: 0.5 - 30 seconds.
 - D. Deceleration Rate Adjustment: 1 - 30 seconds.
 - E. Minimum Adjustment Range for the Lower Output Frequency shall be: 0 to 40 Hertz.
 - F. Minimum Adjustment Range for the Upper Output Frequency Range shall be: 40 to 90 Hertz.
 - G. Minimum Volts/Hertz Range: 3.7 to 8.6 volts/Hertz.
 - H. Provide MANUAL-OFF-AUTOMATIC selector switch and manual analog speed control mounted on the front of the enclosure.
 - I. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.
 - J. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.
 - K. Provide adjustable skip frequencies on the drive output (minimum of three ranges).
 - L. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption, and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
 - M. Power-Interruption Protection: After a power interruption, it prevents the motor from re-energizing until the motor has stopped.
 - N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
 - O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
 - P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
 1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.

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5. Overcurrent.
 6. External fault.
- Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (VDC).
 9. Set-point frequency (Hz).
 10. Motor output voltage (V).
- S. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
 - a. 0 to 10-V dc.
 - b. 0-20 or 4-20 mA.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 - e. RS485.
 - f. Keypad display for local hand operation.
 3. Output Signal Interface:
 - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
 - 1) Output frequency (Hz).
 - 2) Output current (load).
 - 3) DC-link voltage (VDC).
 - 4) Motor torque (percent).
 - 5) Motor speed (rpm).
 - 6) Set-point frequency (Hz).
 4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1A) for remote indication of the following:
 - a. Motor running.
 - b. Set-point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.

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- T. Communications: Provide a communications card to interface VFD with Facility Management Control System (FMCS). Coordinate interface requirements with the FMCS provided under Section 23 09 00. Interface shall allow all parameter settings of VFD to be programmed via FMCS control and displayed on FMCS operator workstation. Provide capability for VFD to retain these settings within the nonvolatile memory.
- U. Three-Contactor Manual Bypass:
1. Provide contactors, motor running overload protection, under-voltage and loss of phase protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch or third contactor to allow maintenance of inverter during bypass operation.
 2. All bypass circuitry shall be located within the same enclosure as the variable frequency drive.
 3. All fire alarm and/or smoke control interconnections (e.g., air handling unit shutdown) shall apply regardless of whether control is through VFD or bypass.
 4. Provide a Drive-Bypass Selector Switch.
 5. Provide nameplate with instructions for switching from drive to bypass and from bypass to drive. Provide instructions for isolating VFD for maintenance.
- V. Control:
1. With the "Manual-Off-Auto" switch in the "Manual" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the manual speed potentiometer on the drive door.
 2. With the "Manual-Off-Auto" switch in the "Auto" position and, if applicable, the "Drive-Bypass" in the "Drive" position, the drive shall be controlled by the input signal from an external source.
 3. If applicable, with the "Drive-Bypass" in the "Bypass" position, regardless the position of the "Manual-Off-Auto" switch, the motor shall be connected across the lines and shall be run at full speed.
 4. With the "Manual-Off-Auto" switch in the "Off" position, if applicable, the drive run circuit shall be open and the VFD shall not operate.
 5. If applicable, signal from the fire alarm control panel shall shut down VFD and bypass.
 6. All disconnect switches between VFD and motor(s) shall include an auxiliary contact interlock wired to the VFD fault trip input to shut down the drive upon opening of the disconnect main contacts.

2.6 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. All VFD supplied for fans shall have dynamic or DC injection braking capability to provide a means of rapid deceleration of the AC motor in not more than one (1) minute. Adjust controls to stop the motor within 30 seconds.
- C. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- D. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

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- E. Control Relays: Auxiliary and adjustable time-delay relays.
 - F. Standard Displays:
 - 1. Output frequency (Hz).
 - 2. Set-point frequency (Hz).
 - 3. Motor current (amperes).
 - 4. DC-link voltage (VDC).
 - 5. Motor torque (percent).
 - 6. Motor speed (rpm).
 - 7. Motor output voltage (V).
 - G. Historical Logging Information and Displays:
 - 1. Real-time clock with current time and date.
 - 2. Running log of total power versus time.
 - 3. Total run time.
 - 4. Fault log, maintaining last four faults with time and date stamp for each.
 - H. Fabrication:
 - 1. Enclosure: NEMA 250, Type 1.
 - 2. Finish: Manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. The VFD manufacturer shall provide certification that heat test has been completed.
- B. The Electrical Contractor shall have a factory service engineer present for the start-up, field calibration, and check-out of each VFD installed. Factory service engineer shall be required to return to the site for recalibration or set-up should unit not function as specified during system commissioning. All costs shall be a part of This Contract. Provide tag with date and signature of factory service Engineer on inside cover of each drive.

3.2 INSTALLATION

- A. Install variable frequency drive equipment in accordance with the manufacturer's instructions.
- B. Floor mount VFD on prefabricated or field fabricated supports with controls no higher than 6'-6" and no lower than 3'-0" AFF. Mount supports on 1/2" thick vibration isolation pads set on concrete housekeeping pads.
- C. Provide engraved phenolic nameplates under the provisions of Section 26 05 53.
- D. Connections: All conduit connections to the VFD shall be by flexible conduit.
- E. Input, output, and control wiring shall each be run in separate conduits.
- F. All interlocking required by the drive manufacturer shall be the responsibility of the Electrical Contractor.

3.3 STARTUP AND COMMISSIONING

- A. Verify all settings, parameters, and adjustments with other contractors prior to startup. Make all adjustments and setting to coordinate with controls and equipment.

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- B. Accelerate the motor to full speed and verify operation. Decelerate the motor to a stop and verify operation. Slowly operate the motor over the speed range and check for resonance.
 - C. Make all adjustments and settings to coordinate with controls and equipment prior to Substantial Completion. Verify that drive is set for auto restart after power loss and undervoltage fault.
 - D. Document settings in the Operations and Maintenance manual.

END OF SECTION 23 05 15

SECTION 23 05 29 - HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Sleeves and Seals.
- D. Flashing and Sealing of Equipment and Pipe Stacks.
- E. Cutting of Openings.
- F. Escutcheon Plates and Trim.

1.2 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:

Pipe Size	Hanger Rod Diameter	
	Column #1	Column #2
2" and smaller	3/8"	3/8"
2-1/2" through 3-5/8"	1/2"	1/2"
4" and 5"	5/8"	1/2"

Column #1: Steel pipe.

Column #2: Copper, plastic and fiberglass reinforced pipe.

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:
 - 1. Parking Garage
 - 2. Sallyport
 - 3. Shower/Locker Rooms

2.2 PIPE HANGERS AND SUPPORTS

- A. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).
- B. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.

- C. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each support at a depth not less than the specified insulation. Factory fabricated inserts may be used.

Acceptable Products:

Anvil - Fig. 160, 161, 162, 163, 164, 165
 Cooper/B-Line - Fig. 3160, 3161, 3162, 3163, 3164, 3165
 Erico - Model 630, 631, 632, 633, 634, 635
 Nibco/Tolco - Fig. 260-1, 261-1 1/2, 262-2, 263-2 1/2, 264-3, 265-4

- D. On all insulated piping, provide a semi-cylindrical metallic shield and fire resistant vapor barrier jacket.
- E. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid insulation sections may be used for this application.

Acceptable Products:

Cooper/B-Line - Fig. B3380 through B3384
 Pipe Shields - A1000, A2000
 Erico - Model 124, 127

- F. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more frequently when required by applicable codes (the Illinois Plumbing Code requires 10 foot maximum spacing for support of copper risers), but never at intervals over 15 feet. Support vertical pipes with riser clamps installed below hubs, couplings or lugs. Provide sufficient flexibility to accommodate expansion and contraction without compromising fire barrier penetrations and other fixed take-off locations.

Acceptable Products:

Anvil - Fig. CT121
 Cooper/B-Line - Fig. B3373CT
 Erico - Model 510
 Nibco/Tolco - Fig. 82

- G. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold pipes. Insulate over mounts.

Acceptable Products: Mason RBA, RCA, or BR.

- H. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate temperature range. HYDRA-ZORB clamps are permitted for this application for bare pipes within their temperature limits of -65°F to +275°F.

- I. Unless otherwise indicated, hangers shall be as follows:

1. Clevis Type:

Service: Bare Metal Pipe
 Insulated Cold Pipe
 Insulated Hot Pipe - 3 inches & Smaller

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Anvil	Fig. 260	
Cooper/B-Line	Fig. 3100	Fig. B3100C
Erico	Model 400	
Nibco/Tolco	Fig. 1	Fig. 81PVC

2. Roller Type:
Service: Insulated Hot Pipe - 4 inches and Larger

Acceptable Products:	4" through 6"	8" and Above
Anvil	Fig. 181, 271	Fig. 171, 271
Cooper/B-Line	Fig. 3110, 3117	Fig. 3114, 3117
Erico	Model 610	Model 605
Nibco/Tolco	Fig. 324, 327	Fig. 322, 327

3. Continuous Channel with Clevis Type:

Service: Plastic Tubing
Flexible Hose
Soft Copper Tubing

Acceptable Products:

Cooper/B-Line - Fig. B3106, with Fig. B3106V
Erico - Model 104, with Model 104V
Nibco/Tolco - Fig. 1V

4. Adjustable Swivel Ring Type:

Service: Bare Metal Pipe - 4 inches and Smaller

Acceptable Products:	Bare Steel Pipe	Bare Copper Pipe
Anvil	Fig. 69	
Cooper/B-Line	Fig. B3170NF	Fig. B3170CTC
Erico	Model FCN	102A0 Series
Nibco/Tolco	Fig. 200	Fig. 203

J. Support may be fabricated from U-Channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.

1. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
2. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

K. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

1. Clamp Type:

Service: Bare Metal Pipe
Insulated Cold Pipe
Insulated Hot Pipe - 3 inches and smaller

- a. Clamps in direct contact with copper pipe shall be plastic coated.
- b. Pipes subject to expansion and contraction shall have clamps slightly oversized to allow limited pipe movement.

Acceptable Products:	Bare Steel, Plastic or Insulated Pipe	Bare Copper Pipe
Unistrut	Fig. P1100 or P2500	
Cooper/B-Line	Fig. B2000 or B2400	Fig. BVT
Nibco/Tolco	Fig. A-14 or 2STR	

2. Roller Type:
Service: Insulated Hot Pipe - 4 inches and larger.

Acceptable Products:	4" through 6"	8" and Above
Unistrut	Fig. P2474	Fig. P2474-1
Cooper/B-Line	Fig. B218	Fig. B219
Nibco/Tolco	Fig. ROL-12	Fig. ROL-13

- L. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

1. Beam Clamps:

Acceptable Products:	
Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

2. Concrete Inserts, Single Rod Galvanized:

Acceptable Products:	
Anvil	Fig. 282
Cooper/B-Line	Fig. B3014
Erico	Model 355
Nibco/Tolco	Fig. 310

3. Concrete Inserts, Continuous Strip Galvanized:

Acceptable Products:	
Unistrut Corp	P3200 Series
Cooper/B-Line	Fig. B22-J
Erico	CONCT

4. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.

5. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

- M. Wall supports shall be used where vertical height of structure exceeds minimum spacing requirements. Install wall supports at same spacing as hangers or strut supports along vertical length of pipe runs.

- N. Welding:

1. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu of bolting, clamping, or riveting to the building structural frame. Take adequate precautions during all welding operations for fire prevention and for protecting walls and ceilings from being damaged by smoke.

2.3 FOUNDATIONS, BASES, AND SUPPORTS

- A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.

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2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Concrete Bases (Housekeeping Pads):

1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall extend 3 inches on all sides of the equipment (6 inches larger than factory base).
2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
3. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at 28 days.
4. Equipment requiring bases is as follows:
 - a. Air Handling Unit
 - b. Energy Recovery Unit
 - c. Condensing Units
 - d. Boiler
 - e. Chemical Feed Equipment
 - f. Expansion Tank

C. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

D. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at his expense.

-
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.5 ROOF PENETRATIONS

- A. Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.
- B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges watertight.

2.6 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

2.7 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.
- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.

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- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2.9 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.
- B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

2.10 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

PART 3 - EXECUTION

3.1 HVAC SUPPORTS AND ANCHORS

A. General Installation Requirements:

1. Install all items per manufacturer's instructions.
2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

B. Supports Requirements:

1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method of securing base to roof shall be compatible with roofing materials.
2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
3. Set all concrete inserts in place before pouring concrete.
4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

C. Pipe Requirements:

1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.
2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.

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3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
 4. Piping shall not introduce strains or distortion to connected equipment.
 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. Loads of 100 lbs. or less may be attached anywhere along the top or bottom chords of trusses or joists with a minimum 3' spacing between loads.
 2. Loads greater than 100 lbs. must be hung concentrically and may be hung from top or bottom chord, provided one of the following conditions is met:
 - a. The hanger is attached within 6" from a web/chord joint.
 - b. Additional L2x2x1/4 web reinforcement is installed per manufacturer's requirements.
 3. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
 4. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel and Fiberglass (Std. Weight or Heavier – Liquid Service):	
	1-1/4" & under	7'-0"
	1-1/2"	9'-0"
	2"	10'-0"
	2-1/2"	11'-0"
	3"	12'-0"
	4" & larger	12'-0"

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
2.	Steel (Std. Weight or Heavier – Vapor Service): 1-1/4" and under 1-1/2" 2" & larger	9'-0" 12'-0" 12'-0"
3.	Hard Drawn Copper & Brass (Liquid Service): 3/4" and under 1" 1-1/4" 1-1/2" 2" 2-1/2" 3" 4" 6"	5'-0" 6'-0" 7'-0" 8'-0" 8'-0" 9'-0" 10'-0" 12'-0" 12'-0"
4.	Hard Drawn Copper & Brass (Vapor Service): 3/4" & under 1" 1-1/4" 1-1/2" 2" 2-1/2" & larger	7'-0" 8'-0" 9'-0" 10'-0" 11'-0" 12'-0"
5.	Flexible Plastic Pipe, Flexible Hose, and Soft Copper Tubing:	
	a. Continuous channel with hangers maximum 8'-0" O.C.	
6.	Installation of hangers shall conform to MSS SP-58 and the applicable Plumbing Code.	

END OF SECTION 23 05 29

SECTION 23 05 48 - HVAC VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Vibration Isolation.
- B. Flexible Connectors.

1.2 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this section.
- B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this section.
- C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.
- D. Isolator submittals shall include:
 - 1. Equipment served
 - 2. Type of Isolator
 - 3. Load in Pounds per Isolator
 - 4. Recommended Maximum Load for Isolator
 - 5. Spring Constants of Isolators (for Spring Isolators)
 - 6. Load vs. Deflection Curves (for Neoprene Isolators)
 - 7. Specified Deflection
 - 8. Deflection to Solid (at least 150% of calculated deflection)
 - 9. Loaded (Operating) Deflection
 - 10. Free Height
 - 11. Loaded Height
 - 12. K_x/K_y (horizontal to vertical stiffness ratio – for spring isolators)
 - 13. Materials and Coatings
 - 14. Spring Diameters
- E. Make separate calculations for each isolator on equipment where the load is not equally distributed.
- F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENT

- A. Vibration isolation for this project is subject to seismic restraint requirements of Section 23 05 50.
- B. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.
- C. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection [e.g., 3" for 2" calculated deflection]. The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.
- D. The lateral to vertical stiffness ratio (K_x/K_y) of spring isolators shall be between 0.8 and 2.0.

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- E. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.
 - F. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.
 - G. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

2.2 MOUNTINGS

- A. Type M3:
 - 1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene friction pads.
 - 2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators. Bolt holes shall not be within the springs.
 - 3. All mountings shall have leveling bolts.
 - 4. Acceptable Manufacturers: Mason "SLFH", Kinetics "FDS", Amber/Booth "SW-3, 4", 5" or 6", Vibration Eliminator Co. "OST".

2.3 HANGERS

- A. Type H1:
 - 1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.
 - 2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.
 - 3. Provide hangers with end connections as required for hanging ductwork or piping.
 - 4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics "RH", Aeroflex "RHD", Vibration Eliminator Co. "ALH".
- B. Type H2:
 - 1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.
 - 2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
 - 3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the grommet and short circuiting the spring.
 - 4. Provide end connections for hanging ductwork or piping.
 - 5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics "SRH", Amber/Booth "BSRA", Aeroflex "RSH", Vibration Eliminator Co. "SNC".

C. Type H3:

1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short circuiting of the hanger rod.
2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the grommet and short circuiting the spring.
4. Provide end connections for hanging ductwork or piping.
5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall have a secondary adjustment to transfer the load to the spring and maintain the same position.
6. Deflection shall be indicated by a pointer and scale.
7. Acceptable Manufacturer: Mason "PC30", Kinetics "SFH", Amber/Booth "BSW", Vibration Eliminator Co. "PCS".

2.4 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

A. Type FC1:

1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or molded and cured neoprene. Outdoor units shall be EPDM.
2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.
3. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer.
4. Connectors up to 2" size may have threaded ends.
5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene flanges.
6. All connectors shall be rated for a minimum working pressure of 150 psi at 200°F.
7. Acceptable Manufacturer: Metraflex "Double Cable-Sphere", Minnesota Flex Corp., Mercer "200 Series", Twin City Hose "MS2".

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Provide vibration isolation as indicated on the drawings and as described herein.
- C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.
- D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.

- E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.
- F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

3.2 PIPE ISOLATION

- A. The first five hangers from vibration-isolated equipment shall have spring isolators with the same static deflection as the equipment. Use type H1 or H2 as required for the specified deflection. The next five hangers shall be type H1.
- B. Where piping is floor-supported, use M3 instead of H2.
- C. Use Type FC1 where pressures are lower than 150 psi, temperatures are below 220°F, and the fluid handled is compatible with neoprene and EPDM.
- D. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.
- E. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.
- F. Support piping to prevent extension of flexible connectors.

3.3 VIBRATION ISOLATION OF DUCTWORK

- A. The first three hangers on all fan systems shall be Type H1 with at least 0.20" minimum static deflection.
- B. Provide flexible duct connections as described in Section 23 33 00 at all fan inlets and outlets and on the mechanical room side of all locations where ducts penetrate mechanical room walls.

3.4 VIBRATION ISOLATION SCHEDULE

EQUIPMENT DESIGNATION	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION	FLEXIBLE CONNECTIONS
Inline Pump(s)	NA	M3 or H2 or H3	0.75"	NA
Inline Fans	NA	H2 or H3	Refer to ASHRAE Table	Per Section 23 33 00
Makeup Air Unit (<10 HP)	NA	H2 or H3	0.75"	Per Section 23 33 00

Note 1: AHU internal fan isolation shall be determined by AHU manufacturer. Isolation selected shall be a minimum of 98% efficient at scheduled CFM and static pressure.

COLUMN 1	2	3	4	5	6	7	8	9	10	11	12
ITEM SERVED	MIN DEFL (")	PROPOSED ISOLATOR							CALCULATIONS		
		TAG	MODEL	MAX LOAD (#)	DEFL @ MAX LOAD (")	DEFL TO SOLID (")	FREE HT (")	Kx/Ky	LOAD (#)	DEFL (")	DEFL RATIO

- COLUMN NOTES: Note numbers correspond to the column numbers above.
- Item served should match designation on the design drawings.
 - List the deflection scheduled or specified in the design documents.
 - List the designation for this isolator. This is most useful when one item has multiple different isolators to support its weight.
 - List the manufacturer's complete model designation for the isolator.
 - List the manufacturer's maximum rated load for the isolator.
 - List the isolator deflection at the maximum rated load in column 5.
 - For spring isolators list the deflection when the springs are solid. This is not normally the same entry as in column 6.
 - List the height of the isolator when unloaded. Shop drawings must show where this is measured.
 - List the rated horizontal to vertical stiffness ratio. This must be between 0.8 and 2.0.
 - List the calculated equipment load on each isolator. For items with unequal weight distribution, calculate each isolator separately.
 - List the calculated deflection under the calculated load. For springs this will be column 10*(column 6 / column 5).
 - List the answer from dividing column 7 by column 11. This must be at least 1.5. If not, select an isolator with more nominal deflection.
- GENERAL NOTES:
- When submitting hangers or supports for a weight range, fill in two rows - one for the maximum and one for the minimum weight.

END OF SECTION 23 05 48

SECTION 23 05 53 - HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 23.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. 3M, Bunting, Calpico, Craftmark, Emedco, Kolbi Industries, Seton, W.H. Brady, Marking Services.

2.2 MATERIALS

- A. All pipe markers (purchased or stenciled) shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

<u>O.D. of Pipe or insulation</u>	<u>Marker Length</u>	<u>Size of Letters</u>
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"
2-1/2" to 6"	12"	1-1/4"

Plastic tags may be used for outside diameters under 3/4".

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- D. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- E. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
 - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
 - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.

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4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
 6. Number all tags and show the service of the pipe.
 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at least one corner for easy hanging.

D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

F. Miscellaneous:

1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

3.2 SCHEDULE

A. Pipes to be marked:

Pipe Service	Lettering Color	Background Color
Heating Water Supply	Black	Yellow
Heating Water Return	Black	Yellow
Condensate Drain	Black	Yellow
Refrigerant (Liquid or Suction)	Black	Yellow

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of air systems.
- B. Testing, adjusting, and balancing of heating systems.
- C. Testing, adjusting, and balancing of plumbing systems.
- D. Testing, adjusting, and balancing of energy recovery systems.
- E. Measurement of final operating condition of HVAC systems.

1.2 QUALITY ASSURANCE

- A. Agency shall be a company specializing in the adjusting and balancing of systems specified in this section with minimum three years' experience. Perform work under supervision of AABC Certified Test and Balance Engineer, NEBB Certified Testing, Balancing and Adjusting Supervisor, SMARTA Certified Air and Hydronic Balancer, or TABB Certified Supervisor.
- B. Work shall be performed in accordance with the requirements of the references listed at the start of this section.

1.3 REFERENCES

- A. AABC - National Standards for Total System Balance, 2002.
- B. ADC – Test Code for Grilles, Registers, and Diffusers.
- C. AMCA – Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-1988; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Sixth Edition, 1998.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing, Third Edition, 2002.
- H. TABB – International Standards for Environmental Systems Balance.

1.4 SUBMITTALS

- A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.
- B. Submit certified copies of test reports to the Architect/Engineer for approval.

1.5 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.

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- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
 - C. Refer to PART 4 for required reports.

1.6 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 man-hours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.7 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.

PART 2 - PRODUCTS

NOT APPLICABLE

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. Recorded data shall represent actual measured or observed conditions.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- D. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- F. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 23 09 00 for additional information.
- G. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
 - 1. General Equipment Requirements:
 - a. Equipment is safe to operate and in normal condition.
 - b. Equipment with moving parts is properly lubricated.
 - c. Temperature control systems are complete and operable.
 - d. Proper thermal overload protection is in place for electrical equipment.
 - e. Direction of rotation of all fans and pumps is correct.
 - f. Access doors are closed and end caps are in place.
 - 2. Duct System Requirements:
 - a. All filters are clean and in place. If required, install temporary media.
 - b. Duct systems are clean and free of debris.
 - c. Fire/smoke and manual volume dampers are in place, functional and open.
 - d. Air outlets are installed and connected.
 - e. Duct system leakage has been minimized.
 - 3. Pipe System Requirements:
 - a. Coil fins have been cleaned and combed.
 - b. Hydronic systems have been cleaned, filled, and vented.
 - c. Strainer screens are clean and in place.
 - d. Shutoff, throttling and balancing valves are open.
- B. Report any defects or deficiencies to Architect/Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

- A. $\pm 10\%$ of scheduled values:
 - 1. Adjust air inlets and outlets to $\pm 10\%$ of scheduled values.
 - 2. Adjust piping systems to $\pm 10\%$ of design values.
- B. $+ 5\%$ of scheduled values
 - 1. Adjust outdoor air intakes to within $+ 5\%$ of scheduled values.
 - 2. Adjust exhaust air through energy recovery equipment to within $+5\%$ of scheduled values.

-
- C. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. Once balancing of systems is complete, at least one damper or valve must be 100% open.
- C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
- D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.
- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 GENERAL REQUIREMENTS

- A. Title Page:
 - 1. Project name.
 - 2. Project location.
 - 3. Project Architect.
 - 4. Project Engineer (KJWW Engineering Consultants).
 - 5. Project General Contractor.
 - 6. TAB Company name, address, phone number.
 - 7. TAB Supervisor's name and certification number.
 - 8. TAB Supervisor's signature and date.
 - 9. Report date.
- B. Report Index
- C. General Information:
 - 1. Test conditions.
 - 2. Nomenclature used throughout report.
 - 3. Notable system characteristics/discrepancies from design.
 - 4. Test standards followed.
 - 5. Any deficiencies noted.
 - 6. Quality assurance statement.
- D. Instrument List:
 - 1. Instrument.
 - 2. Manufacturer, model, and serial number.
 - 3. Range.
 - 4. Calibration date.

4.2 AIR SYSTEMS

A. Air Moving Equipment:

1. General Requirements:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer, model, arrangement, class, discharge.
 - d. Fan RPM.
 - e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
 - f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
2. Flow Rate:
 - a. Supply flow rate (cfm): specified and actual.
 - b. Return flow rate (cfm): specified and actual.
 - c. Outside flow rate (cfm): specified and actual.
 - d. Exhaust flow rate (cfm): specified and actual.
3. Pressure Drop and Pressure:
 - a. Filter pressure drop: specified and actual.
 - b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
 - c. Inlet pressure.
 - d. Discharge pressure.

B. Fan Data:

1. Drawing symbol.
2. Location.
3. Manufacturer and model.
4. Flow rate (cfm): specified and actual.
5. Total static pressure: specified and actual. (Indicate measurement locations).
6. Inlet pressure.
7. Discharge pressure.
8. Fan RPM.

C. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

D. Air Terminal (Inlet or Outlet):

1. Drawing symbol.
2. Room number/location.
3. Terminal type and size.
4. Velocity: specified and actual.
5. Flow rate (cfm): specified and actual.
6. Percent of design flow rate.

E. Air Terminal Unit (Terminal Air Box) Data:

1. General Requirements:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer and model.
 - d. Size.
 - e. Type: constant, variable, single, dual duct.

-
2. Flow Rate:
 - a. Cooling maximum flow rate (cfm): specified and actual.
 - b. Minimum flow rate (cfm): specified and actual.
 3. Pressure Drop and Pressure:
 - a. Inlet static pressure during testing (maximum and minimum).

F. Air Flow Measuring Station:

1. Drawing symbol.
2. Service.
3. Location.
4. Manufacturer and model.
5. Size.
6. Flow rate (cfm): specified and actual.
7. Pressure drop: specified and actual.

4.3 HEATING SYSTEMS

A. Pump Data (Heating water Loop Pumps):

1. Existing drawing symbol or equipment TAG
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.
7. Suction Pressure: Operating and shutoff.
8. Discharge Pressure: Operating and shutoff.
9. Final frequency of motor at maximum flow rate (on pumps driven by VFD).

B. Electric Motors (Associated Heating Water Loop Pump Motors):

1. Drawing symbol of equipment served.
2. Manufacturer, Model, Frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps in each phase.

C. Heating Coils:

1. General Requirements:
 - a. Drawing symbol.
 - b. Service.
 - c. Location.
 - d. Manufacturer and model.
 - e. Size.
2. Flow Rate:
 - a. Flow rate (cfm): specified and actual.
 - b. Water flow rate: specified and actual.
3. Temperature:
 - a. Entering air temperature: specified and actual.
 - b. Leaving air temperature: specified and actual.
 - c. Entering water temperature: specified and actual.
 - d. Leaving water temperature: specified and actual.
4. Pressure Drop and Pressure:
 - a. Air pressure drop: specified and actual.
 - b. Steam pressure after valve: specified and actual.
 - c. Water pressure drop: specified and actual.

-
- D. Terminal Heat Transfer Units:
1. General Requirement:
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer and model.
 - d. Include air data only for forced air units.
 2. Flow Rate:
 - a. Flow rate (cfm): specified and actual.
 - b. Water flow rate (gpm): specified and actual.

- E. Hot Water Boiler:
1. General Requirements:
 - a. Drawing symbol.
 - b. Service.
 - c. Location.
 - d. Manufacturer, model, and identification number.
 - e. Control setting: specified and actual.
 2. Temperature:
 - a. Entering water temperature: specified and actual.
 - b. Leaving water temperature: specified and actual.
 3. Flow Rate:
 - a. Flow rate (gpm): specified and actual.
 4. Pressure Drop and Pressure:
 - a. Pressure Drop: specified and actual.

4.4 PLUMBING SYSTEMS

- A. Pump Data:
1. Drawing symbol.
 2. Service.
 3. Manufacturer, size, and model.
 4. Impeller size: specified, actual, and final (if trimmed).
 5. Flow Rate (gpm): specified and actual.
 6. Pump Head: specified, operating and shutoff.

- B. Balancing Valve:
1. Drawing symbol.
 2. Service.
 3. Location.
 4. Size.
 5. Manufacturer and model.
 6. Flow rate (gpm): specified and actual.
 7. Pressure drop: specified and actual.

- C. Gas Fired Water Heater:
1. Drawing symbol.
 2. Service.
 3. Location.
 4. Manufacturer and model.
 5. Capacity (Btuh): specified, nameplate, and actual.
 6. Entering water temperature: specified and actual.
 7. Leaving water temperature: specified and actual.

-
8. Pressure Drop: specified and actual.
 9. Control Setting: specified and actual.

4.5 ENERGY RECOVERY SYSTEMS

A. Air Systems - Air energy recovery devices shall be tested at ambient temperatures of less than 40°F or greater than 85°F.

1. Energy Recovery Wheel:

a. General Requirements:

- 1) Drawing Symbol.
- 2) Location.
- 3) Wheel RPM.

b. Primary Air:

- 1) Primary Entering Air Temperature.
- 2) Primary Leaving Air Temperature.
- 3) Primary Air Pressure Drop.
- 4) Primary Air Flow Rate (cfm).

c. Secondary Air:

- 1) Secondary Entering Air Temperature.
- 2) Secondary Leaving Air Temperature.
- 3) Secondary Air Pressure Drop.
- 4) Secondary Air Flow Rate (cfm).

END OF SECTION 23 05 93

SECTION 23 07 13 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ductwork Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in ductwork insulation application with five years minimum experience. When requested, installer shall submit manufacturer's certificate indicating qualifications.
- B. Materials: UL listed in Category HNKT; flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.
- C. Adhesives: UL listed, meeting NFPA 90A/90B requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Type A: Flexible Fiberglass - Outside Wrap; ANSI/ASTM C553; commercial grade; 0.28 maximum 'K' value at 75°F; foil scrim kraft facing, 1.0 lb./cu. ft. density.
- B. Type B: Semi-rigid Fiberglass Board Wrap - Outside Application; ANSI/ASTM C612, Class 1; 0.25 maximum 'K' value at 75°F; foil scrim kraft facing, 3 lb./cu. ft. density.
- C. Type C: Flexible Fiberglass Liner; ANSI/ASTM C1071; 0.28 maximum 'K' value at 75°F; 1.5 lb/cu ft minimum density; coated air side for 4000 fpm air velocity.
- D. Type G: Preformed rigid fiberglass acoustical liner. ANSI/ASTM C1071; 0.23 maximum 'K' value at 75°F mean temperature; Noise Reduction Coefficient (NRC) per ASTM C423 Type "A" mounting of 0.70 for 1" thickness, 0.90 for 1.5" thickness. Liner shall be factory coated with an anti-microbial agent to prevent fungus and bacteria growth per ASTM G-21 and G-22. Max flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 JACKETS

- A. Vapor Barrier Jackets: Kraft reinforced foil scrim vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 25 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.
- B. Install materials after ductwork has been tested.
- C. Clean surfaces for adhesives.
- D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.

-
- E. Exterior Duct Wrap - Flexible, Type A:
1. Apply with edges tightly butted.
 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively tight.
 3. Seal joints with adhesive backed tape.
 4. Apply so insulation conforms uniformly and firmly to duct.
 5. Provide high-density insulation inserts at trapeze duct hangers and straps to prevent crushing of insulation. Maintain continuous vapor barrier through the hanger.
 6. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
 7. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and loose tape edges are not acceptable.
 8. Staples may be used, but must be covered with tape.
 9. Vapor barrier must be continuous.
 10. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical ducts.
- F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):
1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
 2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square foot. Pins must be long enough to avoid compressing the insulation.
 3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
 4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in addition to pins as needed to prevent sagging on horizontal surfaces.
- G. Interior Insulation - Flexible Duct Liner, Type C:
1. Observation of Duct Lining:
 - a. After installation of ductwork, Architect/Engineer may select random observation points in each system.
 - 1) At each observation point, cut and remove an 18" x 18" section of ductwork and liner for verification of installation.
 - 2) Random observation points based on one opening per 75 lineal ft. of total duct run.
 - b. When any of the observation points shows non-compliance, additional points will be designated by the Architect/Engineer, and observation repeated.
 - c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat tests. Where replacement is not required, correct all non-compliances.

-
- d. At end of observation, repair all duct lining and observation holes by installing standard, insulated, hinged access doors per Section 23 33 00.
 - e. Paint or finish to match adjacent duct surfaces.
2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be long enough to prevent compressing the insulation.
 3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.
 4. Install per the latest edition of the SMACNA Manual.
 5. Leading edges shall be covered as follows:
 - a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner without gaps at transverse joints. Cut liner flush with end of the duct section for tight joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive to the end of each duct section for complete adhesion of the liner. Protect edges from dirt and debris.
 - b. For duct velocities above 3000 fpm, cover leading edges with metal nosing. Use nosing on upstream edges of each section of duct. If the duct can be installed in either direction, provide nosing on each end or clearly mark the duct to allow visual verification after installation. Verify duct velocities based on the scheduled air flow rates and determine where metal nosing is required.
 - c. Install metal nosing in the following locations (regardless of velocity):
 - 1) The first three fittings downstream of all fans.
 - 2) At all duct liner interruptions. This includes fire dampers, access doors, branch connections, and all other locations where the edge of the liner is exposed.
 - 3) Trailing edges of transverse joints do not require metal nosings.
 6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm.
 7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.
 8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation thickness.

3.2 SCHEDULE

- A. Refer to Section 23 31 00 for scheduling of insulation.

END OF SECTION 23 07 13

SECTION 23 07 16 - HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment Insulation.
- B. Equipment Insulation Finishes.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in insulation application with five years minimum experience.
- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).
- C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type C: Glass Fiber Blanket; ANSI/ASTM C612; 0.40 maximum 'k' value at 300°F; 2.5 lb/cu ft.; suitable to 850°F, with all service jacket (ASJ) vapor retarder jacket having 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).

2.2 INSULATION FINISHES

- A. Type 1: Glass Fabric; ASTM D1668, woven glass fabric with two coats of mastic approved for insulation type. Use vapor barrier mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures less than 70°F and having maximum 0.013 perms/inch rating at 0.043 inch dry-film thickness when tested in accordance with ASTM E-96 Procedure B (Foster 30-80 or approved equivalent). Use breather mastics that are approved for both indoor and outdoor use on insulation systems covering surfaces having temperatures 70°F or greater (Foster 35-00 or approved equivalent).
- B. Type 2: All Service Jacket; ASTM C921; Factory or Field Applied; Kraft paper bonded to aluminum foil reinforced with glass fiber; Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Seal all joints with manufacturer approved tape and adhesive to maintain vapor barrier. Indoor use only, if used outdoors add type 4 finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all materials per manufacturer's instructions, codes and industry standards.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.

- C. Do not insulate factory insulated equipment.
- D. Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation. Secure to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier mastic.
- F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items.
- G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.
- H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor. Minimum 2" coverage of insulation.
- I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60°F and/or above 100°F. Verify insulation type and thickness with equipment manufacturer and Architect/Engineer.
- J. Insulate all supports on equipment operating below ambient temperature.

3.2 INSULATION

- A. Type C:
 - 1. Apply with edges tightly butted and joints staggered.
 - 2. Secure with welded pins and washers, 4" from each edge and 16" on center, or 1/2" x 0.015" galvanized steel bands, 12" on center.

3.3 SCHEDULE

Equipment	Insulation Type	Insulation Thickness	Insulation Finish
A. Heating Water Air Separator/Coalescing Filter	C	2"	1 or 2

END OF SECTION 23 07 16

SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 QUALITY ASSURANCE

- A. Applicator: Company specializing in piping insulation application with five years minimum experience.
- B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL 723 (where required).
- C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose, white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723).
- B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 3/4" thick per layer where multiple layers are specified.
- C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75°F; moisture resistant, non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper vapor barrier jacket. Use self-seal all-purpose white kraft jacket for above grade installations.
- D. Type E: Hydrous Calcium Silicate; ASTM C533; rigid molded pipe insulation; asbestos free; 0.40 'K' value at 300°F; 1200°F maximum service temperature; 16 gauge stainless steel tie wires on maximum 12" centers.

2.2 VAPOR BARRIER JACKETS

- A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.

2.3 JACKET COVERINGS

- A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic. Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum flame spread/smoke developed.

2.4 REFRIGERANT PIPE COUPLING

- A. Insulation Coupling: Molded thermoplastic ASTM D1525, -65°F to 275°F, sizes up to 4-1/8" O.D., and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers.
- B. Acceptable Manufacturers: Klo-Shure or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

- A. General Installation Requirements:

- 1. Install materials per manufacturer's instructions, building codes and industry standards.
- 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
- 3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating temperatures above 70°F, with a minimum compressive strength of 50 psi. Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor.
- 4. Neatly finish insulation at supports, protrusions, and interruptions.
- 5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.
- 6. Shields shall be at least the following lengths and gauges:

	Pipe Size	Shield Size
a.	1/2" to 3"	12" long x 18 gauge
b.	4"	12" long x 16 gauge
c.	5" to 6"	18" long x 16 gauge
d.	8" to 14"	24" long x 14 gauge

- 7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written approval from the Authority Having Jurisdiction and the local fire department for authorization and materials approval. If approval has been allowed, the non-rated material shall be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

- B. Insulated Piping Operating Below 60°F:

- 1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.

-
2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
 3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- C. Insulated Piping Operating Between 60°F and 140°F:
1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.
- D. Insulated Piping Operating Above 140°F:
1. Insulate fittings, valves, flanges, and strainers.
 2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.
- E. Refrigerant Piping:
1. On refrigerant piping (25°F and above) and **not** required to meet the 25/50 flame/smoke, provide at each strut or clevis support an insulation coupling to support pipe and to accept insulation thickness of adjoining insulation, to prevent insulation from sagging and crushing. The coupling shall be suitable for planned temperatures, use with specified pipe material, and shall be a 360°, one-piece cylindrical segment. Use mechanical fasteners where coupling cannot be installed on pipe during installation. Contractor shall apply adhesive to ends of insulation entering insulation coupling to maintain vapor barrier.
- F. Exposed Piping:
1. Locate and cover seams in least visible locations.
 2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.

3.3 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use

mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

2. Self-seal insulation may be used on pipes operating below 170°F.

3.4 JACKET COVER INSTALLATION

A. Plastic Covering:

1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position seams to shed water.
2. Solvent weld all joints with manufacturer recommended cement.
3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely. Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps of 1" on circumferential and 1.5" to 2" on longitudinal seams.
5. Use plastic insulation covering on all exposed pipes including, but not limited to:
 - a. All exposed piping in areas noted on drawings.
 - b. All exposed piping in locker rooms.
 - c. All exposed piping below 8'-0" above floor.
 - d. All piping in mechanical rooms and/or tunnels that is subject to damage from normal operations. (Example: Piping that must be stepped over routinely.)
 - e. All piping in parking garage and sally port.
 - f. All exterior refrigerant piping.

3.5 SCHEDULE

	Piping System	Insulation Type/Thickness
A.	Cooling Coil Condensate Drains below 55°F	B / 1/2"
B.	Heating Water Supply & Return	
	Under 1-1/2"	A / 1-1/2"
	1-1/2" and above	A / 2"
C.	Refrig. Hot Gas Lines	
	Up to 1-1/4"	B / 1/2"
	1-1/2" and up	B / 1" (2 layers of 1/2")
D.	Refrig. Suction Lines (40°F & Above)	
	Up to 1-1/4"	B / 1/2"
	1-1/2" and above	B / 1" (2 layers of 1/2")
E.	Insulation Inserts at hangers	C or E - Match pipe insulation thickness

END OF SECTION 23 07 19

SECTION 23 09 00 – CONTROLS

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PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Complete System of Automatic Controls.
- B. Control Devices, Components, Wiring and Material.
- C. Instructions for Owners.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years' experience.
- B. TCC: Company specializing in the work of this section with minimum five years temperature control experience.
- C. Technician: Minimum five years' experience installing commercial temperature control systems.
- D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians within 100 miles of the job site.

1.3 SUBMITTALS

A. Equipment Coordination:

- 1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.
- 2. Control valve selections shall be based on flow rates shown in approved shop drawings.
- 3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Shop Drawings:

- 1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop drawings in Adobe Acrobat (.pdf) format to the Owner for review.
- 2. Cross-reference **all** control components and point names in a single table located at the beginning of the submittal with the **identical** nomenclature used in this section.
- 3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations, control panel locations and a description of the communication type, media and protocol.
- 4. System Architecture: Provide riser diagrams of wiring between central control unit and all control panels. This shall include specific protocols associated with each level within the architecture. Identify all interface equipment between CPU and control panels. The architecture shall include interface requirements with other systems including, but not limited to, security systems, lighting control, fire alarm, elevator status, and power monitoring system.
- 5. Diagrams shall include:
 - a. Wiring diagrams and layouts for each control panel showing all termination numbers.

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- b. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing of the central system installation. Label all cables and ports with computer manufacturers' model numbers and functions. Show all interface wiring to the control system.
 - c. Identification of all control components connected to emergency power.
 - d. Schematic diagrams for all field sensors and controllers.
 - e. A schematic diagram of each controlled system. The schematics shall have all control points labeled. The schematics shall graphically show the location of all control elements in the system.
 - f. A schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, label it with the same name. Label all terminals.
 - g. A tabular instrumentation list for each controlled system. The table shall show element name, type of device, manufacturer, model number and product data sheet number.
 - h. All installation details and any other details required to demonstrate that the system will function properly.
 - i. All interface requirements with other systems.
6. The network infrastructure shall conform to the published guidelines for wire type, length, number of nodes per channel, termination, and other relevant wiring and infrastructure criteria as published. The number of nodes per channel shall be no more than 80% of the defined segment (logical or physical) limit in order to provide future system enhancement with minimal infrastructure modifications.
 7. Sequences: Submit a complete description of the operation of the control system, including sequences of operation. The description shall include and reference a schematic diagram of the controlled system. **The wording of the control sequences in the submittal shall match verbatim that included in the construction documents to ensure there are no sequence deviations from that intended by the Architect/Engineer. Clearly highlight any deviations from the specified sequences on the submittals.**
 8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point number, the controlled device associated with the I/O point, the location of the I/O device, and reference drawings. Where a control point is the same as that shown on the control system schematic, label it with the same name. Points list shall specifically identify alarms, trends, event history, archive, totalization, graphic points, and all mapped points from other systems (security systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory support information for systems provided and integrated into the FMCS.
 9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of the damper attributes:
 - a. Damper Identification Tag.
 - b. Location.
 - c. Damper Type.
 - d. Damper Size.
 - e. Duct Size.
 - f. Arrangement.
 - g. Blade Type.
 - h. Velocity.

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- i. Pressure Drop.
 - j. Fail Position.
 - k. Actuator Identification Tag.
 - l. Actuator Type.
 - m. Mounting.
10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall include a separate line for each valve and a column for each of the valve attributes:
- a. Valve Identification Tag.
 - b. Location.
 - c. Valve Type.
 - d. Valve Size.
 - e. Pipe Size.
 - f. Configuration.
 - g. Flow Characteristics.
 - h. Capacity.
 - i. Valve C_v .
 - j. Design Pressure Drop.
 - k. Pressure Drop at Design Flow.
 - l. Fail Position.
 - m. Close-off Pressure.
 - n. Valve and Actuator Model Number and Type.
11. Airflow Measuring Station Schedule:
- a. The manufacturer's authorized representative shall prepare the airflow measuring station submittal, or review and approve in writing the submittal prepared by the TCC prior to submission to the Architect/Engineer and prior to installation. The representative shall review air handling equipment submittals and duct fabrication drawings to ensure that all AFMS locations meet the appropriate parameters to achieve proper installation and the specified accuracy. Comply with all manufacturer's installation requirements including straight up and downstream duct lengths. Install airflow straighteners if required by the manufacturer based on installation constraints. The Architect/Engineer shall be notified for approval of any deviations.
 - b. Submit product data sheets for airflow measuring devices indicating minimum placement requirements, sensor density, sensor distribution, and installed accuracy to the host control system.
 - c. Submit installation, operation, and maintenance documentation.
12. Product Data Sheets: Required for each component that includes: unique identification tag that is consistent throughout the submittal, manufacturer's description, technical data, performance curves, installation/maintenance instructions, and other relevant items. When manufacturer's literature applies to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.
13. Provide PICS files indicating the BACnet® functionality and configuration of each device.
14. Provide documentation of submitted products that have been tested and listed by the BACnet Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing and listing has not been completed, a written commitment to upgrade installed controls to a version that meets BTL testing and listing requirements in the event that problems are found during BTL testing is required.

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15. Graphic Display: Include a sample graphic of each system and component identified in the points list with a flowchart (site map) indicating how the graphics are to be linked to each other for system navigation.
 16. Software: A list of operating system software, operator interface software, color graphic software, and third-party software.
 17. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all reports and checklists to be used.
 18. Clearly identify work by others in the submittal.
 19. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.

C. Operation and Maintenance Manual:

1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals in PDF format.
2. Provide three complete sets of manuals.
3. Each O&M manual shall include:
 - a. Table of contents with indexed tabs dividing information as outlined below.
 - b. Definitions: List of all abbreviations and technical terms with definitions.
 - c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors installing equipment and controls and service representatives of each.
 - d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and systems.
 - e. System Components: Alphabetical list of all system components, with the name, address, and telephone number of the vendor.
 - f. Operating Procedures: Include procedures for operating the control systems; logging on/off; enabling, assigning, and reporting alarms; generating reports; collection, displaying, and archiving of trended data; overriding computer control; event scheduling; backing up software and data files; and changing setpoints and other variables.
 - g. Programming: Description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor.
 - h. Engineering, Installation, and Maintenance: Explain how to design and install new points, panels, and other hardware; recommended preventive maintenance procedures for all system components, including a schedule of tasks (inspection, cleaning, calibration, etc.), time between tasks, and task descriptions; how to debug hardware problems; and how to repair or replace hardware. A list of recommended spare parts.
 - i. Original Software: Complete original issue CDs for all software provided, including operating systems, programming language, operator workstation software, and graphics software.

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- j. Software: One set of CDs containing an executable copy of all custom software created using the programming language, including the setpoints, tuning parameters, and object database.
 - k. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and graphics creation and modification. One set of CDs containing files of all color graphic screens created for the project.
- D. Training Manual:
- 1. Provide a course outline and training manuals for each training class.
- E. Record Documents:
- 1. Submit record documentation per Section 23 05 00.
 - 2. Provide a complete set of “as-built” drawings and application software on CDs. Provide drawings as AutoCAD™ or Visio™ compatible files. Provide two copies of the “as-built” drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.
 - 3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including product data and record drawings with revisions clearly indicated. Provide floor plans showing actual locations of control components including panels, thermostats, sensors, and hardware.
 - 4. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.
 - 5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the A/E verifying completion and proper operation of all points.
- 1.4 DELIVERY, STORAGE AND HANDLING
- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.
 - B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.
- 1.5 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION
- A. Control Valves.
 - B. Flow Switches.
 - C. Temperature Sensor Sockets.
 - D. Gauge Taps.
 - E. Automatic Dampers.
 - F. Flow Meters.
- 1.6 AGENCY AND CODE APPROVALS
- A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.
 - 1. UL-916; Energy Management Systems.
 - 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 “Signal Equipment.”

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3. EMC Directive 89/336/EEC (European CE Mark).
 4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.7 ACRONYMS

A. Acronyms used in this specification are as follows:

1. B-AAC BACnet Advanced Application Controller
2. B-ASC BACnet Application Specific Controller
3. BTL BACnet Testing Laboratories
4. DDC Direct Digital Controls
5. FMCS Facility Management and Control System
6. GUI Graphic User Interface
7. IBC Interoperable BACnet Controller
8. IDC Interoperable Digital Controller
9. LAN Local Area Network
10. NAC Network Area Controller
11. ODBC Open DataBase Connectivity
12. OOT Object Oriented Technology
13. OPC Open Connectivity via Open Standards
14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

1.8 SUMMARY

- A. Provide new standalone FMCS for this project with connection to city server system..
- B. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital Controls as shown on the drawings and as described herein.
- C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.
- D. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

1.9 LEED REQUIREMENTS

- A. This project shall meet the requirements of the U.S. GREEN BUILDING COUNCIL LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (LEED) program.
- B. This project will attempt to achieve the U.S. Green Building Council's LEED Version 3.0 certification Level: Silver.
- C. This Contractor shall carefully examine the LEED portion of this specification for full compliance with the following LEED points:
 1. "Energy & Atmosphere": Prerequisite 1, "Fundamental Building Systems Commissioning," Prerequisite 2 - "Minimum Energy Performance," Credit 3 - "Additional Commissioning," and Credit 5 - "Measurement and Verification," as described by LEED.

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2. "Indoor Environmental Quality": Prerequisite 1 - "Minimum IAQ Performance," Credit 1 - "Outdoor Air Delivery Monitoring," Credit 2 - "Increased Ventilation," Credit 6 - "Controllability of Systems," Credit 6.1 - "Lighting Control," and Credit 6.2 - "Thermal Comfort."
 3. All labor and materials required for these and any other LEED initiatives shall be provided without additional cost to the Owner.

1.10 SYSTEM DESCRIPTION

- A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.
- B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall connect to the Owner's local or wide area network, depending on configuration. Provide access to the system, either locally in each building or remotely from a central site or sites, through standard Web browsers, via the Internet, and/or via local area network.
- C. Provide materials and labor necessary to connect factory supplied control components.
- D. Provide central and remote hardware, software, and interconnecting wire and conduit.
- E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Owner.
- F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.

1.11 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation, data files, configuration tools, and application-level software developed for the project. This shall include, but is not limited to, all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with all required IDs and passwords for access to any component or software program. The Owner shall determine which organizations shall be named in the SI organization ID ("**orgid**") of all software licenses. Owner shall be free to direct the modification of the "**orgid**" in any software license, regardless of supplier.

1.12 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

1.13 WARRANTY

- A. Refer to Section 23 05 00 for warranty requirements.
- B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.

- C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.
- D. Update all software and back-ups during warranty period and all user documentation on the Owner’s archived software disks.

1.14 WARRANTY ACCESS

- A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Acceptable Manufacturers	BACnet Protocol
Honeywell WEBs-AX	●

2.2 SYSTEM ARCHITECTURE

- A. General:
 1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall consist of a network of interoperable, standalone digital controllers, a computer system, graphic user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.
 2. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.
 3. The FMCS shall be based on Tridium’s Niagara Framework and adhere to the open NICS licensing. The FMCS shall be comprised of Java Application Control Engine or Controllers (JACE) within each facility. The system shall support JACE Version 3.8. The JACE shall connect to the local area network, depending on configuration. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network. Each JACE is capable communicate to LonMark/LonTalk (ILC) and/or BACnet (IBC) controllers and other open and legacy protocol systems/devices.
 4. The FMCS shall be based on the NiagaraAX Framework (or “NiagaraAX”), a Java-based framework developed by Tridium. NiagaraAX provides an open automation infrastructure that integrates diverse systems and devices (regardless of manufacturer, communication standard or software) into a unified platform that can be easily managed in real time over the Internet using a standard Web browser. Systems not developed on the NiagaraAX Framework platform are unacceptable.
 5. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk and/or BACnet communication protocols to Java Application Control Engines (JACE) which communicate BACnet TCP/ IP or OBIX TCP/IP to the Niagara AX Server. Niagara AX Supervisor Software to be installed on owner provided server.
 6. The Owner shall be the named license holder of all software associated with any and all incremental work on the project(s). All Niagara AX software licenses shall have the “accept.station.in=*” and “accept.station.out=*” and “accept.wb.in=*” and “accept.wb.out=*” section of the software licenses. The intent is to insure that the installed Niagara AX products may be completely open for integrations. Owner shall be free to direct the modification of any software license, regardless of supplier. In addition, the owner shall receive ownership of all job specific software configuration documentation, data files, and application-level software developed for the project. This shall include all custom, job specific software code and documentation for all configuration and

programming that is generated for a given project and/or configured for use with Niagara Framework (Niagara AX) based controllers and/or servers and any related LAN / WAN / Intranet and Internet connected routers and devices. Any and all required I.D.'s and passwords for access to any component or software program shall be provided to the owner. Provide all software necessary for developing software algorithms in all supervisory, programmable and application specific direct digital controllers which is licensed to the Owner.

7.

B. Open, Interoperable, Integrated Architectures:

1. All components and controllers supplied under this Division shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data are not acceptable.
2. The supplied system must be able to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs are not acceptable.
3. Hierarchical or "flat" topologies are required to have system response times as indicated below and to manage the flow and sharing of data without unduly burdening the customer's internal intranet network.
 - a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.3 NETWORKS

- A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if specified, a local server.
- B. Local area network minimum physical and media access requirements:
 1. Ethernet; IEEE Standard 802.3.
 2. Cable; 100 Base-T, UTP-8 wire, Category 6.
 3. Minimum throughput; 100 Mbps.
- C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run parallel within six feet of electrical high power cables. Route the cable as far from interference generating devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right angles.
- D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at the controller location, with the shield at the sensor/device end of the applicable wire being left long and "safed" off in an appropriate manner.
- E. There shall be no power wiring in excess of 30 VAC rms run in conduit with communications wiring. In cases where signal wiring is run in conduit with communication wiring, run all communication wiring and signal wiring using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices.

2.4 REMOTE NETWORK ACCESS

- A. For Local Area Network installations, provide access to the LAN from a remote location via the Internet. The Owner shall provide a connection to the Internet to enable this access via high speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly access charges for connection and ISP.

2.5 NETWORK AREA CONTROLLER (NAC)

- A. The TCC shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of NACs required depends on the type and quantity of devices provided under Divisions 23 and 26. The TCC shall determine the quantity and type of devices.
- B. Each NAC shall provide the interface between the LAN or WAN and the field control devices and shall provide global supervisory control functions over the control devices connected to the NAC. It shall execute application control programs to provide:
1. Calendar functions.
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of all controller data.
 7. Network Management functions.
- C. The Network Area Controller shall provide the following hardware features as a minimum:
1. One Ethernet Port – 10/100 Mbps.
 2. One RS-232 port.
 3. One LonWorks Interface Port – 78KB FTT-10A (for LonWorks systems only).
 4. One RS-485 port.
 5. Battery backup.
 6. Flash memory for long-term data backup. (If battery backup or flash memory is not supplied, the controller shall contain a hard disk with at least 1 gigabyte storage capacity.)
 7. The NAC must be capable of operation over a temperature range of 32°F to 122°F.
 8. The NAC must be capable of withstanding storage temperatures of between 0°F and 158°F.
 9. The NAC must be capable of operation over a humidity range of 5% RH to 95% RH, non-condensing.
- D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. Databases resident on the NAC shall be ODBC-compliant or must provide an ODBC data access mechanism to read and write data stored within it.
- E. The NAC shall support standard Web browser access via the Internet or an intranet and a minimum of five (5) simultaneous users.
- F. Event Alarm Notification and Actions:
1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 2. The NAC shall be able to route any alarm condition to any defined user location whether connected to a LAN, remote via dial-up telephone connection, or WAN.

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3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
 - a. Alarm
 - b. Normal
 4. Provide for the creation of a minimum of eight alarm classes with different routing and acknowledgement properties, e.g. security, HVAC, Fire, etc.
 5. Provide timed (scheduled) routing of alarms by class, object, group, or node.
 6. Provide alarm generation from binary object "runtime" and/or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- G. Treat control equipment and network failures as alarms and annunciated.
- H. Annunciate alarms in any of the following manners as defined by the user:
1. Screen message text.
 2. E-mail of the complete alarm message to multiple recipients. Provide the ability to route and e-mail alarms based on:
 - a. Day of week.
 - b. Time of day.
 - c. Recipient.
 3. Pagers via paging services that initiate a page on receipt of e-mail message.
 4. Graphic with flashing alarm object(s).
 5. Printed message, routed directly to a dedicated alarm printer.
- I. The FMCS shall record the following for each alarm:
1. Time and date.
 2. Location (building, floor, zone, office number, etc.).
 3. Equipment tag.
 4. Acknowledge time, date, and user who issued acknowledgement.
 5. Number of occurrences since last acknowledgement.
- J. Give defined users proper access to acknowledge any alarm.
- K. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be available for review by the user.
- L. Provide a "query" feature to allow review of specific alarms by user-defined parameters.
- M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
- N. An error log to record invalid property changes or commands shall be provided and available for review by the user.

2.6 BACNET FMCS

- A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and proprietary communication protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE Standard 135 (BACnet) to assure interoperability between all system components is required. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).
- C. Interoperable BACnet Controller (IBC):
1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps, terminal air boxes (TAB) and other applications. The application control program shall reside in the same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS document showing the installed system's compliance level to ANSI/ASHRAE Standard 135. Minimum compliance is Level 3.
 2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:
 - a. BACnet Building Controller(s) (B-BC).
 - b. BACnet Advanced Application Controller(s) (B-ACC).
 - c. BACnet Application Specific Controller(s) (B-ASC).
 3. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than 10 Mbps.
 4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the POT.
 5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3 compliance. Controllers offering application selection only (non-programmable) require a 10% spare point capacity to be provided for all applications. Store all control sequences within or programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.
 6. The Contractor supplying the IBCs shall provide documentation for each device, with the following information at a minimum:
 - a. BACnet Device; MAC address, name, type and instance number.
 - b. BACnet Objects; name, type and instance number.
 7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each IBC.
- D. Object Libraries
1. A standard library of objects shall be included for development and setup of application logic, user interface displays, system services, and communication networks.
 2. The objects in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to

group objects created in their application and store the new instances of these objects in a user-defined library.

3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line accessible (over the Internet) library, available to all registered users, to provide new or updated objects and applications as they are developed.
4. All control objects shall conform to the control objects specified in the BACnet specification.
5. The library shall include applications or objects for the following functions, at a minimum:
 - a. Scheduling Object: The schedule must conform to the schedule object as defined in the BACnet specification, providing seven-day plus holiday and temporary scheduling features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders to speed creation and selection of on-off events.
 - b. Calendar Object: The calendar must conform to the calendar object as defined in the BACnet specification, providing 12-month calendar features to allow for holiday or special event data entry. Data entry to be by graphic "point-and-click" selection. This object must be "linkable" to any or all scheduling objects for effective event control.
 - c. Override Object: Provide override object that is capable of restarting equipment turned off by other energy saving programs to maintain occupant comfort or for equipment protection.
 - d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to start equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled unoccupied time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start-stop time object properties based on historical performance.
 - e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to monitor a demand value and predict (using a sliding window prediction algorithm) the demand at the end of the user-defined interval period (1 to 60 minutes). This object shall also accommodate a utility meter time sync pulse for fixed interval demand control. Upon a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per day), the demand limiting object shall issue shed commands to either turn off user specified loads or modify equipment setpoints to provide the desired energy reduction. If the list of sheddable equipment is not enough to reduce the demand to below the setpoint, display a message on the user's screen (as an alarm) instructing the user to take manual actions to maintain the desired demand. The shed lists are specified by the user and shall be selectable to be shed in either a fixed or rotating order to control which equipment is shed the most often. Upon suitable reductions in demand, the demand-limiting object shall restore the equipment that was shed in the reverse order in which it was shed. Each sheddable object shall have a minimum and maximum shed time property to provide both equipment protection and occupant comfort.
6. The library shall include control objects for the following functions:
 - a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide a time delay filter property to prevent nuisance alarms caused by temporary excursions above or below the user defined alarm limits.
 - b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for data sharing.

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- c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for data sharing. The user must be able to specify either input condition for alarming. This object must also include the capability to record equipment runtime by counting the amount of time the hardware input is in an “on” condition. The user must be able to specify either input condition as the “on” condition.
 - d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for data sharing. Properties to enable minimum on and off times for equipment protection as well as start-to-start delay must be provided. Incorporate the BACnet Command Prioritization priority scheme to allow multiple control applications to execute commands on this object with the highest priority command being invoked. Provide 16 levels of priority as a minimum. Systems not employing the BACnet method of contention resolution are not acceptable.
 - e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard for data sharing. Each individual property must be adjustable to allow proportional control only, or proportional with integral control, or proportional, integral and derivative control.
 - f. Comparison Object: Allow a minimum of two analog objects to be compared to select either the highest, lowest, or equality between the two linked inputs. Also, allow limits to be applied to the output value for alarm generation.
 - g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or maximum, or the sum, difference, or average of linked objects. Also, allow limits to be applied to the output value for alarm generation.
 - h. Custom Programming Objects: Provide a blank object template for the creation of new custom objects to meet specific user application requirements. This object must provide a simple BASIC-like programming language that is used to define object behavior. Provide a library of functions including, but not limited to, math and logic functions and string manipulation. Also, provide a comprehensive on-line debug tool to allow complete testing of the new object. Allow new objects to be stored in the library for reuse.
 - i. Interlock Object: Provide an interlock object that provides a means of coordination of objects within a piece of equipment, such as an air handler or other similar types of equipment. An example is to link the return fan to the supply fan such that, when the supply fan is started, the return fan object is also started automatically without the user having to issue separate commands or to link each object to a schedule object. In addition, the control loops, damper objects, and alarm monitoring (such as return air, supply air, and mixed air temperature objects) will be inhibited from alarming during a user-defined period after startup to allow for stabilization. When the air handler is stopped, the interlocked return fan is also stopped, the outside air damper is closed, and other related objects within the air handler unit are inhibited from alarming, thereby eliminating nuisance alarms during the off period.
 - j. Temperature Override Object: Provide an object whose purpose is to override a binary output to an “on” state in the event a user-specified high or low limit value is exceeded. Link this object to the desired binary output object as well as to an analog object for temperature monitoring to cause the override to be enabled. This object will execute a start command at the Temperature Override level of start/stop command priority, unless changed by the user.
 - k. Composite Object: Provide a container object that allows a collection of objects representing an application to be encapsulated to protect the application from tampering or to more easily represent large applications. This object must have the ability to allow the user to select the appropriate parameters of the “contained” application that are represented on the graphic shell of this container.

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7. The object library shall include objects to support the integration of devices connected to the Network Area Controller (NAC). Provide the following as part of the standard library included with the programming software:
- a. LonMark/LonWorks Devices: These devices shall include, but not be limited to, devices for control of HVAC, lighting, access, and metering. Provide LonMark manufacturer-specific objects to facilitate simple integration of these devices. Support all network variables defined in the LonMark profile. The device manufacturer shall provide information (type and function) regarding network variables not defined in the LonMark profile.
 - b. For devices not conforming to the LonMark standard, provide a dynamic object that can be assigned to the device based on network variable information provided by the device manufacturer. Device manufacturer shall provide an XIF file, resource file, and documentation for the device to facilitate device integration.
 - c. For BACnet devices, provide the following objects:
 - 1) Analog In.
 - 2) Analog Out.
 - 3) Analog Value.
 - 4) Binary.
 - 5) Binary In.
 - 6) Binary Out.
 - 7) Binary Value.
 - 8) Multi-State In.
 - 9) Multi-State Out.
 - 10) Multi-State Value.
 - 11) Schedule Export.
 - 12) Calendar Export.
 - 13) Trend Export.
 - 14) Device.
 - d. For each BACnet object, provide the ability to assign the object a BACnet device and object instance number.
 - e. For BACnet devices, provide the following support at a minimum:
 - 1) Segmentation.
 - 2) Segmented Request.
 - 3) Segmented Response.
 - 4) Application Services.
 - 5) Read Property.
 - 6) Read Property Multiple.
 - 7) Write Property.
 - 8) Write Property Multiple.
 - 9) Confirmed Event Notification.
 - 10) Unconfirmed Event Notification.
 - 11) Acknowledge Alarm.
 - 12) Get Alarm Summary.
 - 13) Who-has.
 - 14) I-have.
 - 15) Who-is.
 - 16) I-am.
 - 17) Subscribe COV.
 - 18) Confirmed COV notification.
 - 19) Unconfirmed COV notification.
 - 20) Media Types.

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- 21) Ethernet.
 - 22) BACnet IP Annex J.
 - 23) MSTP.
 - 24) BACnet Broadcast Management Device (BBMD) function.
 - 25) Routing.

2.7 TERMINAL AIR BOX (TAB) CONTROLLERS

- A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings shown on the drawings. Refer to Section 23 36 00 for additional information.
- B. The controller shall support various digital and analog inputs and outputs as needed for damper control, control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of independent occupancy scheduling.
- C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and perform its own limit and status monitoring and alarms to limit unnecessary communications.
- D. Operator interface to any ASC point data or programs shall be through network resident programs or portable operator's terminal connected to the specific controller.
- E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such that a power failure of any duration does not necessitate reprogramming of the controller.
- F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance and BTL listing.

2.8 DATA COLLECTION AND STORAGE (TRENDING REQUIREMENTS)

- A. The NAC shall be able to collect data for any property of any object and store resident in the NAC that shall have, at a minimum, the following configurable properties:
 - 1. Designating the log as interval or deviation.
 - 2. For interval logs, configure the object for time of day, day of week and the sample collection interval.
 - 3. For deviation logs, configure the object for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - 4. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full or rollover the data on a first-in, first-out basis.
 - 5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
- B. Store all log data in a relational database in the NAC that is accessible from a server (if the system is so configured) or a standard Web browser.
- C. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
- D. All log data shall be available to the user in ALL the following data formats:
 - 1. HTML.
 - 2. XML.

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3. Plain text.
 4. Comma or tab separated values.
- E. The NAC shall archive its log data either locally (to itself) or remotely to a server or other NAC on the network. Provide the ability to configure the following archiving properties:
1. Archive on time of day.
 2. Archive on user-defined number of data stores in the log (buffer size).
 3. Archive when log has reached its user-defined capacity of data stores.
 4. Provide ability to clear logs once archived.

2.9 AUDIT LOG

- A. Provide and maintain an audit log that tracks all activities performed on the NAC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network, or to a server. For each log entry, provide the following data:
1. Time and date.
 2. User ID.
 3. Change or activity: i.e., change setpoint, add or delete objects, commands, etc.

2.10 DATABASE BACKUP AND STORAGE

- A. The NAC shall automatically backup its database on a user-defined time interval.
- B. Store copies of the current database and, at the most, the recently saved database in the NAC. The age of the most recently saved database shall depend on the user-defined database save interval.
- C. Store the NAC database in XML format to allow viewing and editing. Other formats are acceptable as long as XML format is supported.

2.11 GRAPHIC USER INTERFACE SOFTWARE

- A. Operating System:
1. Provide computer with the most current Microsoft-based operating system with which the GUI has proven compatibility.
- B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu pulldowns and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line) that displays the location and the selected object identification.
- C. Point Organization: Organize points by equipment categories, location, or other means acceptable to Owner.
- D. Real-Time Displays: The GUI shall support the following graphic features and functions:
1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file. Use of proprietary graphic file formats is not acceptable. In addition to, or in lieu of, a graphic background, the GUI shall support the use of scanned pictures.
 2. Graphic screens shall be able to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and links to other graphic screens.

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3. Graphics shall support layering, and each graphic object shall be configurable for assignment to a layer. A minimum of six layers shall be supported.
 4. Modifying common application objects, such as schedules, calendars, and setpoints, shall be accomplished graphically.
 - a. Schedule times shall be adjusted using a graphic slider without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by using a graphic calendar without requiring any keyboard entry from the operator.
 5. Commands to start and stop binary objects shall be made by selecting the object and the appropriate command from a pop-up menu. No text entry shall be required.
 6. Adjustments to analog objects, such as setpoints, shall be made by selecting the object and using a graphic slider to adjust the value. No text entry shall be required.
- E. System Configuration: At a minimum, the GUI shall include the necessary software and components to enable the operator to perform the following tasks with proper password access:
1. Create, delete or modify control strategies.
 2. Add/delete objects.
 3. Tune control loops by adjusting control loop parameters.
 4. Enable or disable control strategies.
 5. Generate hard copy records or control strategies on a printer.
 6. Select alarm points and define the alarm state.
 7. Select points to be trended and initiate the recording of values automatically.
 8. View any trend as a graph.
- F. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- G. Security: Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system administrator shall be able to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall be automatically logged off the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. Store all system security data in an encrypted format.
- H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. Annunciate the failure of any device to the operator.
- I. Alarm Console:
1. The system shall have a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and to acknowledge the alarm.
 2. When the alarm console is enabled, a separate alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator are not acceptable. The use of the alarm console can be enabled or disabled by the system administrator.

2.12 WEB BROWSER CLIENTS

- A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, Firefox™, or Chrome. Systems requiring additional software to enable a standard Web browser to reside on the client machine, or manufacturer-specific browsers, are not acceptable.
- B. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphic User Interface. Systems that require different views or that require different means of interacting with objects, such as schedules or logs, are not permitted.
- C. The Web browser client shall provide:
 - 1. User log-on identification and password shall be required. If an unauthorized user attempts access, display a blank web page. Implement security using Java authentication and encryption techniques to prevent unauthorized access.
 - 2. Graphic screens developed for the GUI shall be the same screens used for the Web browser client. The web browser interface shall support all animated graphic objects supported by the GUI.
 - 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
 - 4. Store all graphic screens in the Network Area Controller (NAC) without requiring any graphics storage on the client machine.
 - 5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
 - 6. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:
 - a. Modify common application objects, such as schedules, calendars, and setpoints, graphically.
 - 1) Schedule times shall be adjustable using a graphic slider, without requiring any keyboard entry from the operator.
 - 2) Holidays shall be set using a graphic calendar, without requiring any keyboard entry from the operator.
 - b. Commands to start and stop binary objects shall be made by right-clicking the selected object and selecting the appropriate command from a pop-up menu. No text entry shall be required.
 - c. View logs and charts.
 - d. View and acknowledge alarms.
 - e. Setup and execute SQL queries on log and archive information
 - 7. The system shall be able to specify a user’s (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just his/her defined home page. From the home page, links to other views or pages in the system shall be possible, if allowed by the system administrator.
 - 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.

2.13 UNINTERRUPTIBLE POWER SUPPLY (UPS)

- A. A UPS shall be provided for each of the following:
 - 1. FMCS workstations and servers.
 - 2. Network area controllers.
 - 3. Chiller plant manager.
 - 4. Boiler plant manager.
- B. Provide a 120 volt 60 Hz line-interactive uninterruptible power supply with backup battery capacity for 5 minutes at 100% load. UPS shall have hot swappable batteries, automatic battery self-test and start-on-battery capabilities. Batteries shall be valve regulated, sealed lead acid type. UPS shall have sine wave shape output waveform. UPS shall be UL 1778 list and comply with FCC Part 15, Class A.
- C. Acceptable Manufacturers: Sola/Hevi-Duty, Eaton Powerware, APC.

2.14 SYSTEM PROGRAMMING

- A. The GUI software shall perform system programming and graphic display engineering. Access to the GUI software shall be through password access as assigned by the system administrator.
- B. Provide a library of control, application, and graphic objects to enable creation of all applications and user interface screens. Applications shall be created by selecting the control objects from the library, dragging or pasting them on the screen, and linking them together using a built-in graphic connection tool. Completed applications may be stored in the library for future use. GUI screens shall be created in the same fashion. Data for the user displays shall be obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Provide all software tools or processes to create applications and user interface displays.
- C. Programming Methods
 - 1. Provide the capability to copy objects from the supplied libraries or from a user-defined library to the user's application. Link objects with a graphic linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification. Links will vary in color depending on the type of link; e.g., internal, external, hardware, etc.
 - 2. Configuration of each object shall be done through the object's property sheet using fill-in-the-blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration is not acceptable.
 - 3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system.
 - 4. All programming shall be done in real time. Systems requiring the uploading, editing, and downloading of database objects are not allowed.
 - 5. The system shall support object duplication in a customer's database. An application, once configured, can be copied and pasted for easy reuse and duplication. All links, other than to the hardware, shall be maintained during duplication.

2.15 DDE DEVICE INTEGRATION

- A. The NAC shall support the integration of device data via Dynamic Data Exchange (DDE) over the Ethernet network. The NAC shall act as a DDE client to another software application that functions as a DDE server.
- B. Provide the required objects in the library included with the Graphic User Interface programming software to support the integration of these devices into the FMCS. Objects provided shall include, at a minimum:
 - 1. DDE Generic AI Object.
 - 2. DDE Generic AO Object.
 - 3. DDE Generic BO Object.
 - 4. DDE Generic BI Object.

2.16 MODBUS SYSTEM INTEGRATION

- A. The NAC shall support integration of device data from Modbus RTU, ASCII, and TCP control system devices. Connect to the Modbus system via an RS-232, RS485, or Ethernet IP as required by the device.
- B. Provide the required objects in the library included with the GUI programming software to support the integration of the Modbus system data into the FMCS. Objects provided shall include, at a minimum:
 - 1. Read/Write Modbus AI Registers.
 - 2. Read/Write Modbus AO Registers.
 - 3. Read/Write Modbus BI Registers.
 - 4. Read/Write Modbus BO Registers.
- C. The NAC shall perform all scheduling, alarming, logging and global supervisory control functions of the Modbus system devices.
- D. The FMCS supplier shall provide a Modbus system communications driver. The equipment system vendor that provided the equipment using Modbus shall provide documentation of the system's Modbus interface and shall provide factory support at no charge during system commissioning.

2.17 SOFTWARE

- A. IDC/IBCs shall operate totally standalone and independent of a central computer for all specified control applications.
- B. Software shall include a complete operating system (OS), communications handler, point processing, energy management application packages as specified herein, standard control algorithms and specific control sequences (IDC/IBC) and an Owner/user custom control calculation package complete with interpreter.
- C. OS software shall be PROM resident, operate in real time, provide prioritized task scheduling, control time programs, monitor and manage communications, and scan inputs and outputs.
- D. Each IDC/IBC panel shall include the following energy management routines:
 - 1. Time of day scheduling.
 - 2. Optimum start/stop.
 - 3. Peak demand limiting.
 - 4. Economizer control.
 - 5. PID control.
 - 6. Supply air reset.
 - 7. Outdoor air reset.
- E. Input/output point processing software shall include:
 - 1. Update of all connected input and output points at least once per second.

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2. Analog to digital conversion, scaling and offset, correction of sensor non-linearity, sensing no response or failed sensors, and conversion of values to 32-bit floating point format. Retain both the maximum and minimum values sensed for each analog input in memory. It shall be possible to input subsets of standard sensor ranges to the A/D converter and assign gains to match the full-scale 32-bit conversion to achieve high accuracy readout.
 3. A reasonability check on all analog inputs against previous values and discarding of values falling outside preprogrammed reasonability limits.
 4. Assignment of proper engineering units and status conditions to all inputs and outputs.
 5. Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and alarm) to an input or to assign a set of floating limits (alarm a reset schedule or FMCS control point) to the input. Assign each alarm a unique differential to prevent a point from oscillating in and out of alarm. Make alarm comparisons of each scan cycle.
 6. Adjustment of timing from two seconds to two minutes in one-second increments to eliminate nuisance alarms on startup.
- F. Command Control software shall manage the receipt of commands from the server and from control programs.
1. Provide command delay to prevent simultaneous energizing of loads. Delay must be programmable from 0 to 30 seconds.
 2. Assign each command a command and residual priority to manage conflicts created by multiple programs having access to the same command point. Allow only outputs with a higher command priority to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
 3. A "fixed mode" option (override) shall allow inputs to and outputs from control programs to set to a fixed state or value. When in the "fixed mode", assign inputs and outputs high residual command priority to prevent override by application programs.
- G. Alarm lockout software shall prevent nuisance alarms. On initial start-up of mechanical equipment, assign a "timed lockout" period to analog points to allow them to reach a stable condition before activating alarm comparison logic. Lockout period shall be programmable for each point from 0 to 90 minutes in one-minute increments.
- H. A "hard lockout" shall also be provided to positively lock out alarms when equipment is turned off or when a true alarm depends on the condition of an associated point. Hard lockout points and lockout initiators shall be operator programmable.
- I. Runtime shall be accumulated based on the status of a digital input point. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Runtime counts shall reside in non-volatile memory and have DCP resident runtime limits assignable through the operator's terminal.
- J. A transition counter shall count the number of times a device is cycled on or off. Counter shall be non-volatile and capable of counting 600,000 cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
- K. Custom IDC/IBC programs shall meet the control strategies called for in the sequence of operation of these specifications. Each IDC/IBC shall have resident in its memory and available to the programs a full library of IDC/IBC algorithms, intrinsic control operators, arithmetic, logic, and relational operators. Provide the following features:
1. Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self-learning). Use Adaptive Control where the controlled flow rate is

variable (such as TAB units and variable flow pumping loops). The adaptive control algorithm shall monitor the loop response to output corrections and adjust the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm shall operate in a continuous self-learning manner and shall retain in memory a stored record of the system dynamics so that, on system shutdown and restart, the learning process starts from where it left off. Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.

2. All IDC/IBC setpoints, gains and time constants associated with IDC/IBC programs shall be available to the operator for display and modification via the operator workstation.
 3. The execution interval of each IDC/IBC loop shall be adjustable from 2 to 120 seconds in one-second increments.
 4. IDC/IBC control programs shall assign initialization values to all outputs so controlled devices assume a failsafe position on start-up.
- L. Provide time and event programming (TEP) capability to initiate a controlled sequence of events for execution at a specific time or upon the occurrence of an event. Minimum program features required are:
1. Analog points commandable to a specific value.
 2. Digital points commandable to a specific state; e.g. on or off; fast, slow or off.
 3. Initiator to be a specific day and time or a specific event; e.g. an alarm.
 4. Manual initiation via operator's command.
 5. Commands must honor command delays (to prevent current surges), and assigned minimum ON and OFF times.
 6. Commands must honor command and residual priority structures allowing higher priority commands (like smoke control) to override lower priority commands (like time of day scheduling) and residual priority.
 7. Ability to chain TEPs.
 8. Ability to enable and disable TEPs individually.
 9. Ability to enable/disable TEP initiators.
- M. Store Energy Management application programs and associated data files in non-volatile or 72-hour battery backed RAM memory. Individual programs shall be accessible from the operator workstation for enabling/disabling and program parameter modification and shall include:
1. Time Programs:
 - a. Provide an independent start and stop program time for each system identified in the points list.
 - b. It shall be possible to assign two independent start and stop times/days to any equipment connected to a controller.

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2. Exception Day Scheduling:
 - a. Provide an Exception Day program for holiday and other planned exceptions to time programs. Exception schedules shall be DSC resident and operator programmable up to one year in advance.
 - b. The program shall allow definition of up to 32 exception time spans. Define each span by calendar start day and calendar stop day.
 3. An IDC/IBC resident temporary scheduler shall allow operators to modify present time program control of equipment. Minimum feature set required is:
 - a. Ability to alter time schedules as much as six days in advance.
 - b. Ability to alter either start time, stop time or both for each day.
 - c. Temporary schedule shall be in effect for all days specified.
 - d. Automatically delete the temporary schedule and restore program to normal schedule after execution.
 - e. Ability to assign schedule changes as permanent as well as temporary.
 - N. The IDC/IBC shall have built-in, non-descriptive, self-test procedure for checking the indication lights, digital display, and memory. It shall display advisories for maintenance, performance, and/or software problems.
 - O. All electronics shall be:
 1. Standard locally stocked modular boards.
 2. Plug-in type.
 3. Furnish all ROM programs unlocked.

2.18 CONTROL DAMPERS

- A. Rectangular Control Dampers - Standard Construction:
 1. Shall be licensed to bear the AMCA Certified Rating Seal.
 2. Test leakage and pressure drop per AMCA 500.
 3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk or weld seams to prevent leakage.
 4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).
 5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
 6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
 7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.

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8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
 9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
 10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
 11. Maximum Leakage: 9 cfm at 1" w.c. pressure differential for a 24"x24" damper.
 12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8,000 cfm through a 24"x24" damper (2000 fpm).
 13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8,000 cfm through a 24"x24" damper (2000 fpm).
- B. Thermally Insulated Control Damper:
1. Shall be licensed to bear the AMCA Certified Rating Seal.
 2. Test leakage and pressure drop per AMCA 500.
 3. Frame: Extruded aluminum, minimum 4" deep, 0.080" minimum thickness. Frame shall be insulated with Styrofoam on three sides if installed in duct and four sides if flanged to duct.
 4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, internally insulated with expanded polyurethane foam and thermally broken, with overlapping blades and blade seals (overlapping blade seals only is unacceptable).
 5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
 6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
 7. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
 8. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
 9. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
 10. Maximum Leakage: 15 cfm at 1" w.c. pressure differential for a 24"x24" damper.
 11. Maximum Pressure Drop: 0.21" for 8,000 cfm through a 24"x24" damper (2000 fpm).

2.19 DAMPER ACTUATORS

A. Damper Actuators - Electronic - Spring Return:

1. Damper actuators shall be UL listed, electronic direct coupled with spring return to normal position for modulating or two-position control as noted in the sequence of control. Actuator shall be 24 VAC with proportional control, electronic overload protection to prevent actuator damage due to over-rotation and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).
2. Following power interruption, spring return mechanism shall close the damper. Mechanical spring shall be rated for a minimum of 60,000 full cycles. Provide breathable membrane in actuator housing to compensate for pressure differential and allow for 95% non-condensing relative humidity in the airstream.
3. Mount actuators with motor outside of airstream whenever possible. Unit casings shall have housing with proper weather, corrosive, or explosion-proof construction as required by application.
4. Actuators shall be rated for 60,000 full cycles at rated torque with 2-year unconditional warranty. Size actuators per damper manufacturer's recommendations.
5. Provide end switches as required for the sequence of operation.
6. Provide analog feedback signal for positive position indication. Refer to FMCS points list.
7. Acceptable manufacturer: Honeywell or Belimo

2.20 HYDRONIC CONTROL VALVES

A. General:

1. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 2 psi.
2. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 1 to 4 psi, except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 2 psi.
3. Two-way valves shall be 100% tight-closing. Three-way valves shall be 100% tight-closing in both extreme positions.
4. Modulating two-way valves shall have equal percentage flow characteristics.
5. Modulating three-way valves shall have linear flow characteristics.
6. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves, butterfly valves, or non-characterized valves.

B. Two-position:

1. Ball 2" and under:
 - a. Design Pressure: 400 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 150 psi

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- b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470°F melting point of 95-5 solder).
- 2. Ball 3" to 6":
 - a. Design Pressure: 200 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 35 psi
 - b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and seals, flanged ends.
 - 3. Butterfly 2-1/2" to 12":
 - a. Design Pressure: 125 psi
Design Temperature: -20 to 212°F
Design Flow Differential Pressure Rating: 50 psi
 - b. Cast iron body, stainless steel stem with extended neck, aluminum-bronze or nickel-plated iron disc, EPDM seats and seals, fully lugged ends.
- C. Modulating:
- 1. Globe 1/2" to 2":
 - a. Design Pressure: 250 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 35 psi
 - b. Bronze or brass body, trim and plug; stainless steel stem; stainless steel or bronze seat; EPDM or PTFE packing; threaded ends.
 - 2. Globe 2-1/2" to 6":
 - a. Design Pressure: 125 psi
Design Temperature: 250°F
Design Flow Differential Pressure Rating: 25 psi
 - b. Cast iron body, bronze or brass trim and plug; stainless steel stem; bronze seat; EPDM or PTFE packing; flanged ends.
 - 3. Ball 2" and under:
 - a. Design Pressure: 400 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 35 psi
 - b. Bronze or brass body, nickel plated brass or stainless steel stem, chrome plated brass or stainless steel ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated for soldering in line with 470°F melting point of 95-5 solder).

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4. Ball 3" to 6":
 - a. Design Pressure: 200 psi
Design Temperature: 212°F
Design Flow Differential Pressure Rating: 35 psi
 - b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and seals, flanged ends.
 5. Butterfly 2-1/2" to 12":
 - a. Design Pressure: 125 psi
Design Temperature: -20 to 212°F
Design Flow Differential Pressure Rating: 50 psi
 - b. Cast iron body, stainless steel stem with extended neck, aluminum-bronze or nickel-plated iron disc, EPDM seats and seals, fully lugged ends.

2.21 VALVE ACTUATORS

A. General:

1. Actuators shall be sized to operate the valve through its full range of motion and shall close against pump shutoff pressure without producing audible noise at any valve position.
2. Provide visual position indication.
3. Mount actuator directly on valve or provide linear motion assembly as required for valve type.

B. Valve Actuators - Electronic:

1. Actuator shall be UL listed and provided with NEMA housing for applicable environment, electronic overload protection to prevent actuator damage due to over-rotation, and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew fasteners not acceptable).
2. Actuators shall be rated for 60,000 full stroke cycles at rated torque. Stall motor not acceptable.
3. Tri-state/floating actuators shall have auto-zeroing function for realigning valve position.
4. Proportional actuator position shall be proportional to analog or pulse width modulating signal from electronic control system.
5. Spring return actuators shall have an internal spring return mechanism. Non-mechanical forms of fail-safe operation are not acceptable.
6. Provide analog feedback signal for positive position indication as required by control diagrams.
7. Acceptable Manufacturer: Honeywell or Belimo.

2.22 CONTROL INSTRUMENTATION

A. Temperature Measuring Devices:

1. Electric Thermostats:

- a. Single Temperature - Line Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5°F, concealed temperature adjustment, locking cover, rated for load, single or double pole as required.
- b. Single Temperature - Low Voltage Electric: Integral manual ON/OFF/AUTO selector switch, minimum dead band of 5°F, anticipator circuits, concealed temperature adjustment, locking cover, 24 V control transformer (if not included with unit under control), single or double pole as required.

2. Low Limit Switch:

- a. Provide one foot of sensing element for each one square foot of coil area, maximum element length 25 feet, of the vapor tension type, so that any point along the entire length of measuring element is capable of triggering the switch.
- b. Provide 3" minimum radius capillary support clips at each turn.
- c. Furnish each thermostat with one single pole, single throw normally-opened switch and one single pole, single throw normally-closed auxiliary switch.
- d. Setpoint range shall be 15°F to 55°F with a permanent stop at 35°F.
- e. Differential shall be fixed at approximately 5°F and supplied with manual reset.

B. Temperature Sensors:

1. Room Temperature Sensor:

- a. Sensor Only: Honeywell TR23, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, no setpoint adjustment or override button.
- b. Sensor with Setpoint Adjustment: Honeywell TR 71, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a single warmer/cooler or red/blue visual scale), no override button.
- c. Sensor with Override: Honeywell TR 71, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, occupied/unoccupied override button with LED, no setpoint adjustment.
- d. Sensor with Setpoint Adjustment and Override: Honeywell TR 71, Two-piece construction, ventilated plastic enclosure, off-white color, thermistor sensing element or resistance temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single setpoint adjustment (no numeric temperature scale – provide with a warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.

2. Duct Temperature Sensor:

- a. Thermistor or RTD type. Pneumatic transmitters with transducers are not acceptable.

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- 3. Water Temperature Sensor:
 - a. Install in immersion wells. Separate thermometers as specified elsewhere, also of the immersion well type, shall be installed within 2 feet of each temperature sensor.

 - C. Humidity Measuring Devices:
 - 1. Humidity Sensors:
 - a. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic service. Accuracy shall be $\pm 2\%$ of reading.

 - D. Pressure Measuring Devices
 - 1. Differential Pressure Switches:
 - a. Standard Pressure Switches:
 - 1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.
 - 2) Accuracy shall be $\pm 3\%$ of full scale maximum throughout entire range at 70°F.
 - 3) Provide mounting brackets, probes, and shutoff valves required for proper installation.
 - 4) The range and service shall be as required for application or as noted on the drawings.
 - 5) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for both high or low limit alarms or controls.
 - 6) Provide latching relays that require manual reset once activated.
 - 7) Acceptable Manufacturer: Dwyer Photohelic Series 3000.
 - b. High Pressure Switches (Manual Reset):
 - 1) Differential pressure switch with single pole, double-throw snap switch and enclosure.
 - 2) Rated for pressure specified in sequence of control.
 - 3) Electrical rating shall be 15 amps at 120-480 volts.
 - 4) Setpoint adjustment shall be screw type located inside enclosure.
 - 5) Provide optional manual reset for overpressure protection with all tubing, brackets, and adapters.
 - 6) Repeatability: $\pm 3\%$.
 - 2. Pressure Transmitters/Transducer:
 - a. Select device suitable for intended application; water or air, static or differential.
 - b. Select for appropriate range, including negative if applicable.

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- c. 100% solid state device, temperature compensated, suitable for pressures of 200% rated range with averaging to stabilize output, accuracy of $\pm 1\%$ full scale, and a 4-20 mA output.
 - d. Provide a NEMA 4 enclosure unless panel mounted.
 - e. Air service shall have a minimum of three field selectable ranges.
 - f. When used for room pressure control, the transducer shall be bidirectional with a range of $\pm 0.1"$ W.C.
 - g. Provide pressure line outlet cover on both sides of the wall when used for room pressure control.
 - h. Furnish with integral LED's to indicate Zero Pressure, Pressure In Range, and Pressure Out Of Range as a diagnostic aid.

E. Flow Measuring Devices:

1. Flow Switches:

- a. Suitable for the intended application (water or air system).
- b. Vane Operated Flow Switch: Vane motion shall activate a single pole, double throw snap switch.

2. Insertion Type Electromagnetic Flow Meter:

a. General:

- 1) Each flow meter shall be of the magnetic insertion type.

b. Service:

- 1) Heating Water: Rated for minimum of 240°F service.

c. Insertion Type Electromagnetic Flow Meter:

- 1) Each meter shall be rated for system pressure and shall have adequate structural integrity for a flow rate equal to 150% of the scheduled maximum initial or future flow rate, whichever is greater.

- 2) Each insertion type electromagnetic flow meter shall be complete with all hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter shall be hand insertable up to 400 PSI.

3) Construction:

- a) Wetted Components: 316 stainless steel
- b) Sensor Head: Polypropylene
- c) Electronics enclosure shall be NEMA 4 and aluminum.

- 4) Each meter shall be wet calibrated against a primary volumetric standard that is accurate to within 0.1% and traceable to NIST.

d. Output:

- 1) Output signals shall be completely isolated and shall consist of the following:

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- a) High resolution frequency output for use with peripheral devices such as display module or BTU meter.
 - b) Analog output; 4-20mA, 0-10V, or 0-5V jumper selectable.
 - c) Scalable dry contact output for totalization.
- 2) The output shall be connected with display unit.
 - 3) The meter shall include 25 feet of cable to connect with a remotely mounted display unit.
 - 4) Unless indicated otherwise, the initial span adjustment of each transmitter shall be 0-120% of the scheduled maximum flow rate.
- e. Accuracy:
 - 1) The accuracy of each meter/transmitter assembly shall be $\pm 1.0\%$ of flow rate reading over a range of 3-15 feet/second fluid velocity, with a repeatability of 0.1%. Accuracy at 1 foot/second shall be $\pm 2.0\%$.
 - f. Display Unit:
 - 1) Pair with Display Unit described below.
 - g. BTU Meter:
 - 1) Pair with BTU Meter described below.
 - h. Calibration:
 - 1) Each meter shall be calibrated on a NIST traceable flow stand at 1, 8, and 15 FPS. Provide written documentation of calibration.
 - i. Installation Hardware
 - 1) The flow meter shall be supplied with standard installation hardware, which shall include, but not be limited to, full port bronze ball valve, brass close nipple and weld-on carbon steel branch outlet.
 - j. Warranty:
 - 1) Provide performance warranty of at least two years from the date of installation and startup. Warranty shall cover parts and labor for repair or replacement of the meter assembly. Performance during the warranty period shall satisfy the above-stated requirements for accuracy and repeatability.
 - k. Approved Manufacturers:
 - 1) ABB, Onicon, Magmeter.
- 3. Display Unit:
 - a. General:
 - 1) The display shall compatible with virtually any flow meter.

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- 2) The display module shall provide a local indication of liquid flow rate and net totalized flow, along with associated engineering units (e.g., GPM/second and gallons).
 - 3) House in a steel wall-mounted enclosure with a built-in user interface/display.
 - 4) Display unit shall accept 4-20 mA pulse or contact closure flow signals. It shall also function as a network interface for two (2) additional analog rate inputs and one (1) additional totalizing pulse input.
 - 5) It shall support BACnet communication protocols.
 - 6) The display shall have two-line alphanumeric LCD displays of flow rate and flow total.
 - 7) The display shall have non-volatile EEPROM memory that retains all program parameters and totalized values in the event of power loss.
 - 8) Electrical Power Supply: 24VAC. 60Hz, 500mA max.
- b. Approved Manufacturers:
- 1) Onicon, Yokogawa.

4. Airflow Measuring Stations:

- a. In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, any AFMS used to measure outside air CFM shall have an accuracy of $\pm 15\%$ of the design minimum outdoor air flow rate (or better). The AFMS accuracy shall also comply with requirements outlined in the following paragraphs of this specification.
- b. Duct Mounted Airflow Measuring Stations (AFMS) - Thermal Dispersion
 - 1) Provide airflow/temperature measurement devices where indicated on the plans.
 - 2) Each AFMS shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.
 - a) Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
 - b) Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.
 - c) Devices using chip-in-glass or diode-case chip thermistors are not acceptable.
 - d) Devices using less than two thermistors in each sensor assembly are not acceptable.
 - e) Devices using platinum wire RTDs are not acceptable.
 - f) Devices having electronic circuitry mounted in or at the sensor probe are not acceptable.

- g) Pitot tubes and arrays are not acceptable.
- h) Vortex shedding devices are not acceptable.

3) All Sensor Probes

- a) Each sensor assembly shall independently determine the velocity and temperature at its measurement point.
- b) Each sensor assembly shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).
- c) Airflow measuring station assembly accuracy shall be +/-2% of Reading over the entire operating airflow range. Temperature accuracy shall be +/-0.15° F between -20° F and 160° F.
- d) The operating humidity range for each sensor probe shall be 0-99% RH (non-condensing).
- e) Each sensor probe shall have an integral, UL listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.
- f) The number of probes shall be as recommended by the manufacturer to achieve the specified accuracy.

4) Duct and Plenum Probes

- a) Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.
- b) Probe assembly mounting brackets shall be constructed of 304 stainless steel.
- c) The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

5) Sensor Density

<u>Area (sq.ft.)</u>	<u>Total # of Sensors Required</u>
< 2	4
2 to < 4	6
4 to < 8	8
8 to < 16	12
≥ 16	16

6) Transmitters

- a) The transmitter shall have an integral 16 character alphanumeric LCD display capable of simultaneously displaying individual airflow and temperature.
- b) The transmitter shall be capable of field configuration and diagnostics using an on-board interface and LCD display.

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- c) The operating temperature range for the transmitter shall be -20° F to 120° F.
 - d) The transmitter shall be capable of communicating with other devices using one of the following interface options:
 - (1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)
 - (2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP, Modbus-RTU or Johnson Controls N2-Bus. BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.
 - (3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a Windows 2000 or Windows XP based PC.
 - (4) LonWorks Free Topology
- c. Fan Inlet Airflow Measuring Stations (AFMS) - Thermal Dispersion:
- 1) Sensor assemblies shall be mounted on 304 stainless steel housings.
 - 2) Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
 - 3) Mounting feet shall be constructed of 304 stainless steel and securely riveted in place to prevent loosening over time due to vibration.
 - 4) The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.
 - 5) Transmitters
 - a) The transmitter shall have an integral 16 character alphanumeric LCD display capable of simultaneously displaying individual airflow and temperature.
 - b) The transmitter shall be capable of field configuration and diagnostics using an on-board interface and LCD display.
 - c) The operating temperature range for the transmitter shall be -20° F to 120° F.
 - d) The transmitter shall be capable of communicating with other devices using one of the following interface options:
 - (1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0-10VDC/4-20mA (4-wire)

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- (2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP, Modbus-RTU or Johnson Controls N2-Bus. BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.
 - (3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a Windows 2000 or Windows XP based PC.
 - (4) LonWorks Free Topology

6) The AFMS shall be UL listed as an entire assembly.

d. Fan Inlet Airflow Measuring Stations - Differential Pressure:

1) Fan Inlet Measuring Station Pressure Sensors, Transmitters and Transducers:

a) Select for appropriate pressure range, fan type, inlet velocity, and airflow volume.

b) Transmitter features and minimum performance requirements shall be as follows:

- (1) Combined Accuracy: $\pm 0.50\%$.
- (2) Terminal Point Nonlinearity: $\pm 0.40\%$.
- (3) Hysteresis: $\pm 0.02\%$.
- (4) Non-repeatability: $\pm 0.05\%$.
- (5) Compensation Range:

- (a) Zero Shift: $\pm 0.025\%$ FS/ $^{\circ}$ F.
- (b) Span Shift: 0.025% FS/ $^{\circ}$ F.

(6) Differential Overpressure: 5 psi proof and 25 psi burst pressure.

(7) Output signal: 0 to 10 VDC.

c) Each transducer shall be provided with an integral manual zeroing valve to allow for field calibration of the zero reference value without the need for shutting the operating system down.

d) System airflow (measured in CFM) shall be continuously displayed on an LCD display meter (0.5 inches high by 3.5 digits) located on the face of the air volume/velocity transducer control enclosure.

e. Mounting of fan inlet static pressure sensing elements shall be in accordance with manufacturer's published installation instructions to ensure accuracy of readings.

F. Current Measuring Devices:

1. Current Switches for Constant Speed Motors:

a. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the

monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.

2. Current Switches for Motors Controlled by VFD:

- a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with NO output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.

G. Occupancy Sensors:

1. Ceiling mounted, passive infrared, 360° coverage pattern, zero crossing circuitry, adjustable sensitivity and time delay (initial setting: Time delay - 5 minutes), integral isolated relay with normally open and normally closed outputs, LED indicator, five-year warranty, UL listed. TCC shall submit manufacturer supplied sensor layout drawing for shop drawing review. Provide full room coverage as recommended by manufacturer.

H. Combination Carbon Monoxide/Nitrogen Dioxide Sensors:

1. Solid-state gas sensor/transmitter for each gas, NEMA 1 gasketed enclosure, normal operating temperature 0-120°F, normal relative humidity operation 5-95%, ± 5% accuracy, and detection range of 0-200 ppm.
2. Provide separate 4-20 mA output from the sensor to the FMCS system for each gas.
3. Install with spacing per manufacturer and OSHA requirements.
4. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's recommendations.

I. Carbon Dioxide Sensors:

1. Microprocessor based non-dispersive infrared sensor with range of 0 to 2,000 ppm CO₂ with ± 100 ppm accuracy, maximum drift (compensated) of ± 5% full scale in five years, VOC software and hardware sensing, duct mounting where applicable, 0-10V dc or 4-20 mA output directly proportional to ppm, adjustable alarm limit, membrane filter, and terminal block. The diffusion gas chamber in the sensor shall incorporate a reflective light pipe or wave guide surrounded by a gas permeable membrane that prevents particulate contamination of the sensor. Unit shall have selectable IAQ mode with output signal and sum of CO₂ and VOC levels.

J. Miscellaneous Devices:

1. Control Relays:

- a. Form "C" contacts rated for the application with "push-to-test" contact transfer feature and an integral LED to indicate coil energization.
- b. Mount all relays and power supplies in a NEMA 1 enclosure beside the FMCS panel or controlled device and clearly label their functions.

2. Thermostat and Sensor Enclosures:

- a. Clear plastic guard with lock. Wire guard with tamperproof screws. Setpoint shall be adjustable with cover in place. Fasten to wall separately from thermostat. Provide guards in all corridors, gymnasiums, locker rooms, toilet rooms, assembly halls and as noted on the drawings.

3. Twist Timers:

- a. Wall-mounted heavy duty, with rotary dial and face graduated in minutes or hours as noted. Unit shall fit behind standard "decorator" wall plate. Color of timer and face plate shall match remainder of project. Verify with Electrical Contractor. Provide wall plate and engraved plastic label indicating service.
- b. Switch shall be rated for 20 amps at 125 volts (10 amps at 277 volts) and fit standard 2-1/2" deep electrical box.
- c. Provide time cycle noted on the drawings or in the specifications; up to 12 hours.
- d. Acceptable Manufacturers: Paragon SWD Series, Tork A500 Series, Intermatic FD Series, or Marktime Series 93.

2.23 CONDUIT

- A. Conduit and Fittings: Refer to Electrical Section 26 05 33 for materials and sizing.

2.24 WIRE AND CABLE

- A. Wire and Cable Materials: Refer to Electrical Section 26 05 13 for wire and cable materials.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Install system and materials in accordance with manufacturer's instructions.
- C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.
- D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.
- E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed 48". In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.
- F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.
- G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.

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- H. After completion of installation, test and adjust control equipment.
- I. Check calibration of instruments. Recalibrate or replace.
- J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.
- K. All controls associated with the proper operation of air handling units, pumps, or other mechanical equipment served by emergency power shall be connected to the emergency power system. Control components shall not be powered from the life safety branch of the emergency power system. Coordinate emergency power source connections with the Architect/Engineer.
- L. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.
- M. Labels For Control Devices:
1. Provide labels indicating service of all control devices in panels and other locations.
 2. Labels may be made with permanent marking pen in the control panels if clearly legible.
 3. Use engraved labels for items outside panel such as outside air thermostats.
 4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.
- N. VFDs:
1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.
 2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.
 3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.
 4. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.
 5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.
- O. Airflow Stations:
1. The transmitter shall be installed at a location that is protected from weather, water, and vibration.
 2. Mount transmitter where they can easily be read (36" to 66" above floor). Do not fasten transmitters directly to ductwork or compromise duct insulation.
 3. The manufacturer's authorized representative shall visit the project site during construction prior to station installations to confirm all submitted sizes, mounting requirements and locations. Size adjustments shall be made at no additional cost. The representative shall meet on site with the TCC to support and train them on proper installation procedures and calibration.
 4. Install labels at each sensor and transmitter identifying its service.

3.2 GRAPHIC DISPLAY

- A. Create a customized graphic for each piece of equipment indicated on the itemized points list.
- B. Components shall be arranged on graphic as installed in the field.
- C. Include each graphic point listed in the itemized points list using real time data.
- D. Provide a graphic representation of the following:
 - 1. Where there are multiple buildings, color code the campus map by the systems serving that building. The building graphic shall be linked to the graphic for that building's systems.
 - 2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU and TAB by floor.
 - 3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be linked to the graphic for that area's AHU.
 - 4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for that zone. The zone shall be linked to the graphic for that zone's TAB graphic.
 - 5. Show the location of each thermostat on the floor plan.
 - 6. Provide separate graphics showing the chilled and heating water system flow diagram. Show temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.
 - 7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that piece of equipment.
- E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:
 - 1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air Relative Humidity, Enthalpy, KWH, KW, etc.
 - 2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of space sensors and major mechanical equipment.
 - 3. Detailed graphics for each mechanical system including AHUs, ERUs, EFs, chillers, and boilers, as a minimum.
 - 4. Access corresponding system drawings, technical literature, and sequences of operations directly from each system graphic.
- F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:
 - 1. Project control as-built documentation including all TCS drawings, diagrams and sequences of operation.
 - 2. TCS Bill of Material for each system, e.g. AHU, RTU, FCU, boiler, etc.
 - 3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.

3.3 CONDUIT INSTALLATION

- A. Conduit Sizing and Installation: Refer to Electrical Section 26 05 33 for execution and installation.
 - 1. Thermostats/temperature sensors shall be installed in junction boxes, flush with the wall, and shall be coordinated for orientation with Architect/Engineer.

3.4 WIRE AND CABLE INSTALLATION

- A. Wire and Cable Materials Installation: Refer to Electrical Section 26 05 13 for execution and installation.
- B. Field Quality Control:
 - 1. Inspect wire and cable for physical damage and proper connection.
 - 2. Torque test conductor connections and terminations to manufacturer's recommended values.
 - 3. Perform continuity test on all conductors.
 - 4. Protection of cable from foreign materials:
 - a. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
 - b. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.
- C. Installation Schedule:
 - 1. Conduit terminations to all devices installed in applications with rotating equipment, expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the National Electrical Code, shall be connected using flexible conduit rated for the environment.

3.5 FMCS INSTALLATION

- A. Coordinate voltage and ampacity of all contacts, relays, and terminal connections of equipment being monitored or controlled. Voltage and ampacity shall be compatible with equipment voltage and be rated for full ampacity of wiring or overcurrent protection of circuit controlled.
- B. Naming Conventions: Coordinate all point naming conventions with Owner standards. In the absence of Owner standards, naming conventions shall use equipment designations shown on plans.

3.6 COMMISSIONING

- A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.
- B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.
- C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25% spare capacity for future expansion.
- D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.7 PREPARATION FOR BALANCING

- A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- B. Check the calibration and setpoints of all controllers.
- C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
- D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum cfm.
- E. Verify the operation of all interlock systems.

3.8 TEST AND BALANCE COORDINATION

- A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.
- C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.
- D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.9 DEMONSTRATION AND ACCEPTANCE

- A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

3.10 TRAINING

A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 8 hours of training on consecutive days for 4 Owner's representatives. The training course shall enable the Owner's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

B. Day-to-Day Operations - Training Description:

1. Proficiently operate the system.
2. Understand control system architecture and configuration.
3. Understand FMCS systems components.
4. Understand system operation, including FMCS system control and optimizing routines (algorithms).
5. Operate the workstation and peripherals.
6. Log-on and off the system.
7. Access graphics, point reports, and logs.
8. Adjust and change system setpoints, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.
10. Understand system drawings and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from FMCS controllers and ASCs.
13. Operate portable operator's terminals.

C. Advanced Operations - Training Description:

1. Make and change graphics on the workstation.
2. Create, delete, and modify alarms, including annunciation and routing of these.
3. Create, delete and modify point trend logs and graph or print these both on and ad-hoc basis and at user-definable time intervals.
4. Create, delete, and modify reports.
5. Add, remove, and modify system's physical points.
6. Create, modify and delete programming.
7. Add panels when required.
8. Add operator interface stations.
9. Create, delete, and modify system displays, both graphic and others.
10. Perform FMCS system field checkout procedures.
11. Perform FMCS controller unit operation and maintenance procedures.
12. Perform workstation and peripheral operation and maintenance procedures.
13. Perform FMCS system diagnostic procedures.
14. Configure hardware including PC boards, switches, communication, and I/O points.
15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
16. Adjust, calibrate, and replace system components.

D. System Management - Training Description:

1. Maintain software and prepare backups.
2. Interface with job-specific, third-party operator software.
3. Add new users and understand password security procedures.

- E. Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section. The instructor(s) shall provide one copy of training material per student.

3.11 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.

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- B. Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
 - D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
 - E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.
 - F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
 - G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.
 - H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.

3.12 INSTALLATION OF FLOW METERS

- A. Provide manufacturer's recommended lengths of straight piping upstream and downstream of the flow meter. Up to 30 diameters upstream of the flow meter may be required depending on the piping arrangement and flow meter type.
- B. Maintain adequate pull/service space.

END OF SECTION 23 09 00

SECTION 23 09 13 - INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pressure Gauge.
- B. Pressure Gauge Accessories.
- C. Thermometers.
- D. Test Plugs.
- E. Static and Differential Airflow Pressure Gauges.

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

- A. Gauges shall be 4-1/2" diameter with aluminum or stainless steel case with phosphor bronze bourdon tube, brass socket for air, steam, water or oil application, 1/4" or 1/2" bottom connection. Gauges shall be 1% full scale accurate with bronze brushed brass movement and adjustable pointer. Standard ranges to be either pressure or pressure and vacuum as required of application.
- B. Acceptable Manufacturers: Ashcroft, Marsh, Marshalltown, Miljoco, Trerice, U.S. Gauge Figure 1901, Weiss, Weksler, Wika.
- C. Select gauge range for normal reading near center of gauge.

2.2 PRESSURE GAUGE ACCESSORIES

- A. All pressure gauges shall have valves and pressure snubbers. All pressure gauges on steam shall have pigtail syphon.
- B. Shutoff Valve: 1/4" ball valve as specified for each piping system.
- C. Pressure snubber, brass with 1/4" connections, porous metal type.

2.3 THERMOMETERS

- A. Dial Type:
 - 1. 4-1/2" diameter, hermetically sealed case. Stainless steel case and stem. Accuracy of 1% full scale with external recalibrator.
 - 2. Select thermometers for appropriate temperature range. Adjustable elbow joint with locking device to allow rotation of thermometer to any angle.
 - 3. Stem lengths as required for application with minimum insertion of 2-1/2".
 - 4. Thermometers for water, steam, or oil shall have brass or steel separable socket. Socket shall extend through insulation. Thermometers for air shall have an aluminum or brass duct flange.
 - 5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.

2.4 TEST PLUGS

- A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to 500 psi.
- B. Provide extended units for all plugs installed in insulated piping.
- C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and -25°F to 125°F ranges and 5" stems.
- D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

2.5 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES

- A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock and vibration, and rated for 15 psig.
- B. Accuracy shall be ± 3% of full scale maximum throughout entire range at 70°F.
- C. Provide mounting brackets, probes, and shutoff valves required for proper installation.
- D. The range and service shall be as required for application or as noted on the drawings.
- E. Acceptable Manufacturers: Dwyer Magnehelic Series 2000, Marshalltown Instrument Series 85C.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install per manufacturer's instructions.
 - 2. Coil and conceal excess capillary on remote element instruments.
 - 3. Install gauges and thermometers in locations where they are easily read from normal operating level.
 - 4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.
- B. Pressure Gauges:
 - 1. Connect pressure gauges to suction and discharge side of all pumps.
 - 2. Provide snubber for each pressure gauge.
 - 3. Provide coil syphon for each pressure gauge connected to steam piping.
- C. Thermometers:
 - 1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.

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2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION 23 09 13

SECTION 23 21 00 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Heating Water Piping System.

1.2 QUALITY ASSURANCE

- A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not acceptable.
- B. Welding Materials, Procedures, and Operators: Conform to ASME Section 9, ANSI/AWS D1.1, and applicable state labor regulations.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect piping to prevent entrance of foreign matter into pipe and to prevent exterior corrosion.
- B. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 23 05 00 for required hydronic systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

2.1 HEATING WATER

- A. Design Pressure: 125 psig.
Maximum Design Temperature: 225°F. (230°F for mechanical couplings)
- B. Piping - 2" and Under:
 - 1. Tubing: Type L drawn temper seamless copper tube, ASTM B88.
 - 2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22.
- C. Piping - 2-1/2" and Over:
 - 1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
 - 2. Joints: Butt-welded or flanged.
 - 3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
 - 4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges.

D. Shutoff Valves:

1. Ball Valves:

- a. BA-1: 3" and under, 150 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and stem, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- 1) Provide extended shaft with operating handle of non-thermal conductive material and protective sleeve that allows operation of valve, adjustment of the packing, and adjustment of the memory stop without breaking the vapor seal or disturbing the insulation for all valves in insulated piping.
- 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

E. Throttling Valves:

1. Globe Valves:

- a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF, Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T, NIBCO #T-235.
- b. GL-2: 2-1/2" thru 10", 125 psi S @ 353°F, 200 psi WOG @ 150°F, flanged, iron body, bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F, Milwaukee #F2981, Watts #F-501, NIBCO #F-718-B.
- c. GL-5: 2" and under, 300 psi WOG, solder, bronze. Hammond #IB423, Stockham #B24T, Milwaukee #1590, Watts #B-4011-T, NIBCO #S-235.

F. Check Valves:

1. CK-1: 2" and under, 125 psi S @ 353°F, 200 psi WOG @ 150°F, screwed, bronze, horizontal swing. Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000, or NIBCO #T-413.
2. CK-4: 2" and under, 200 psi WOG @ 150°F, solder, bronze, horizontal swing. Crane #1342, Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, or NIBCO #S-413.
3. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716 or #779.

G. Strainers:

1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi WOG @ 150°F. Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO T-122.

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2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi WOG @ 150°F. Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D, Victaulic #732 or #W732, NIBCO F-721-A.

2.2 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.
 1. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.
 2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
- B. Piping Under 1-1/4" Size:
 1. In sizes where drainage type fittings are not available, tees with threaded caps to permit rodding are acceptable.
- C. Shutoff Valves:
 1. Ball Valves:
 - a. BA-1: 3" and under, 125 psi saturated steam, 600 psi WOG, full port, screwed or solder ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham #S-206 BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National Utilities Co., RUB.

NOTES:

- 1) Provide extended shaft for all valves in insulated piping.
- 2) Provide lock out trim for all valves opening to atmosphere installed in domestic water piping over 120°F, heating water piping over 120°F, steam, condensate, boiler feed water piping, compressed air piping and gasoline/kerosene piping, and as indicated on the drawings. Solid extended shaft is not required on valves with lock out trim.

2.3 AIR VENTS

- A. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type, 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.
- B. On branch lines and small heating units - Use coin-operated air vent equal to B&G #4V, attached to 1/8" coupling in top of pipe. Install air vents on all coils and terminal heating units.

2.4 AUTOMATIC AIR VENTS

- A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure and temperature of at least 240°F and 125 psi, 1/2" or 3/4" inlet. B&G #87, Armstrong, Spirotherm, Taco, or Watts.
- B. High/low capacity automatic air vent (for air separator connection). Maximum operating pressure and temperature of at least 240°F and 125 psi, 3/4" inlet, 3/8" minimum outlet. B&G #107, Armstrong, Spirotherm, Taco, or Watts.

2.5 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:

Pipe Size	1/4" - 2"	2-1/2" - 8"	10" and Up
Water	20 mesh	20 mesh	20 mesh

- B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.6 MAKE-UP WATER ACCESSORIES

- A. Pressure Reducing Valve:

1. For water fill lines to hydronic systems.
2. Pressure reducing valve. Removable strainer, field adjustable discharge pressure, brass body, disc and seat, union with 1/2" or 3/4" NPT sweat connection, 125 psig maximum working pressure, 225°F maximum temperature.
3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Thrush, Watts.

- B. Relief Valve:

1. For water fill lines to hydronic systems.
2. Cast iron or bronze body, 1/2" or 3/4" screwed connections, 125 psig working pressure, 225°F maximum temperature. Minimum 500,000 Btuh capacity at 30 psig. Manual test lever.
3. Acceptable Manufacturers: Armstrong, Bell & Gossett, Conbraco, Watts.

- C. Backflow Preventer:

1. Reduced pressure type as scheduled on the drawings.
2. Provide an air gap fitting and piping to drain.
3. If not indicated on the drawings, unit shall be same size as pipe.
4. Field test and tag units per manufacturer's instructions by a certified tester before initial operation.

2.7 SAFETY RELIEF VALVES

- A. SRV-1 (Hydronic Heating Systems): Spring-loaded disc type with cast iron or bronze body, bronze or stainless steel disc, side outlet and lifting lever for maximum service of 125 psig at 250°F. For relieving water during pressure fluctuations and in case of control failure. Capacities shall be ASME Section IV certified and labeled. Acceptable Manufacturers: Kunkle # 537, B&G, Conbraco, McDonnell & Miller, or Watts.

2.8 SUCTION DIFFUSER

- A. Furnish and install on base mounted pumps with inlet size same as pipe size shown on the drawing.
- B. In no case shall pressure drop exceed 1.1 psi.

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- C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder with 3/16" diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice cylinder, with bronze or stainless steel strainer, designed for pressure differential equal to pump shutoff head, with free area at least 5 times cross section area of pump suction opening. Furnish adjustable foot to support weight of suction piping. Orifice cylinder and straightening vanes shall be steel in closed systems and stainless steel in open (cooling tower) systems. Connect drain valve to blowdown connection. Provide 16 mesh bronze startup strainer. The startup strainer shall be removed after the system has been started, cleaned, and is operating under normal conditions, but before the system is turned over to the Owner. Hang the startup strainer on the piping near the pump after it is removed.
 - D. Acceptable Manufacturers: Amtrol, Armstrong, Bell & Gossett, Patterson, Wheatley, Victaulic.

2.9 EXPANSION TANK

- A. Bladder Type:
 - 1. Tank shall be welded steel, ASME construction and stamped.
 - 2. Tank shall be complete with heavy-duty replaceable butyl bladder, charging valve, lifting ring, sight glass, drain tapping, and system connection.
 - 3. 125 psig working pressure and 240°F maximum operating temperature.
 - 4. Acceptable Manufacturers: Thrush, Bell & Gossett, Armstrong, Watts, Wessels, Wheatley, Amtrol, Patterson.

2.10 COALESCING TYPE COMBINATION AIR ELIMINATOR AND DIRT SEPARATOR

- A. Coalescing type air eliminator and dirt separator shall be fabricated from steel and ASME constructed and certified for 125 psi working pressure and 270°F operating temperature. Units 2-1/2 inches and smaller shall have threaded connections. Units 3 inches and larger shall have flanged connections.
- B. Air elimination and dirt separation shall be by coalescing action by either:
 - 1. Stainless steel PALL rings.
 - 2. Copper tubes with continuous wound, permanently attached copper wire and followed by a separate continuous wound permanently affixed copper wire.
- C. Provide brass flushing cock on the separator side to facilitate system fast-fill and to blow down impurities from the water surface within the separator.
- D. Provide factory mounted blow-down valve on the unit bottom to allow for draining and cleaning.
- E. Coalescing separators shall be as sized on the construction drawings, but in no case shall it have less than line size connections nor shall pressure drop exceed 1 psi at design flow. Include on submittal the pressure drop of each unit at its design flow rate.
- F. Coalescing separators shall be equipped with removable cover to allow for removal, inspection and cleaning of the internal coalescing media.
- G. Acceptable Manufacturers: Spirotherm VDN Series, Wessels WVA.

2.11 DRAIN VALVES AND BLOWDOWN VALVES

- A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added 3/4" male hose thread outlet, cap, and retaining chain.

2.12 LOCK OUT TRIM

- A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over 120°F and as indicated on the drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Connect to all equipment with flanges or unions.
- D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

3.2 TESTING PIPING

- A. Heating Water:
 - 1. Test pipes underground or in chases and walls before piping is concealed.
 - 2. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak ruins the insulation, replace all damaged insulation.
 - 3. Test the pipe with 100 psig water pressure. Hold pressure for at least two hours.
 - 4. Test to be witnessed by the Architect/Engineer or their representative, if requested by the Architect/Engineer.
 - 5. Submit signed documentation of pipe testing results within two weeks of completed test to A/E. Coordinate requirements with commissioning agent.

3.3 CLEANING PIPING

- A. Assembly:
 - 1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign matter on internal or external surfaces by means consistent with good piping practice subject to approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
 - 2. During fabrication and assembly, remove slag and weld spatter from both internal and external joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
 - 3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow witnessing the operation. Properly dispose of cleaning and flushing fluids.
 - 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment, open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.

B. Chemical Cleaning:

1. Flush pipe and components with clean water until all discharge from system is clean. Maintain minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as when system is in normal operation. Discharge shall be from low points of pipes, ends of headers and as otherwise needed to flush entire system. After flushing, all residual water shall be drained and/or blown out.
2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If heat is not available, use 3 pounds per 100 gallons.
3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain and until water appears clear.
4. After circulating the chemical cleaner for six hours at 150°F, or 12 hours at less than 90°F, connect fresh water to the system and discharge to a drain. Run circulating pumps and flush until discharge is clear water.
5. When system water is clear, remove, clean and replace all strainers.
6. Coordinate with owner and commissioning agent to review water samples prior to starting chemical treatment.
7. Add chemical treatment as specified in Section 23 25 00.
8. Submit signed documentation of flushing and chemical treatment results to A/E.
9. Water samples may be taken by the Architect/Engineer and/or owner/commissioning agent to verify a clean system. If system is not clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be repeated at the Contractor's expense.
10. Chemical cleaning applies to the following systems:
 - a. Heating Water

3.4 INSTALLATION

A. General Installation Requirements:

1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure, with minimum use of offsets and couplings. Provide only offsets required for needed headroom or clearance and needed flexibility in pipe system.
2. Install piping to conserve building space, and not interfere with other work.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either direction shall continue through the fitting nearest to the indication of a smaller pipe size.
6. Install bell and spigot pipe with bells upstream.

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7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
 8. Branch takeoffs shall be from the top, side, or bottom of piping.
- B. Installation Requirements in Electrical Rooms:
1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment plus its required clearance space.
- C. Valves/Fittings and Accessories:
1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend to 7'-0" above finished floor.
 2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located above ceiling.
 3. Provide clearance for installation of insulation, and access to valves and fittings.
 4. Provide access doors where valves are not exposed.
 5. Install balancing valves with the manufacturers recommended straight upstream and downstream diameters of pipe.
 6. Prepare pipe, fittings, supports, and accessories for finish painting.
 7. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn valves in radiation cabinets and all butterfly valves with stems horizontal.
 8. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that require servicing.
 9. Provide flanges or unions at all final connections to equipment, traps and valves.
 10. Arrange piping and piping connections so equipment may be serviced or totally removed without disturbing piping beyond final connections and associated shutoff valves.

3.5 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject and remove from the job any items which are unsuitable, cracked or otherwise defective.
- B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or nameplates sufficient to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. **2-1/2" and larger fittings shall be long radius type**, unless otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard fittings by cutting and welding standard elbows to form smooth, long radius fittings.

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- F. Use full and double lengths of pipe wherever possible.
 - G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or pump.
 - H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
 - I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

3.6 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate, and venting.
- B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or sectionalized draining. Drain valves are defined above.
- C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install all liquid lines with top of pipe and eccentric reducers in a continuous line.
- D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems. Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall connect the tapping location to a venting device in an accessible location.
- F. All vent and drain piping shall be of same materials and construction as the service involved.

3.7 BRANCH CONNECTIONS

- A. Make branch connections with standard tee or cross fittings of the type required for the service unless otherwise specified herein or detailed on the drawings.
- B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.
- C. Use of forged weld-on fittings is also limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Header or main must be 2-1/2" or over.
 - 3. Branch line is at least two pipe sizes under header or main size.

3.8 JOINING OF PIPE

- A. Threaded Joints:
 - 1. Ream pipe ends and remove all burrs and chips.
 - 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
 - 3. Apply Teflon tape and Teflon compound to male threads.
- B. Flanged Joints:
 - 1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be raised face except when bolted to flat face cast iron flange.
 - 2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME B18.2.1 and B18.2.2.

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3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with an indicating torque wrench for equal tension in all bolts.
 4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21. Unless otherwise specified, gaskets shall meet the following requirements:
 - a. Gasket material and thickness approved by manufacturer for intended service, chemical compatibility, pipe system test pressure, and operating temperature range.
 - b. Maximum pressure rating of at least 250 psig.
 - c. Minimum temperature rating: -10°F.
 - d. Maximum temperature rating of at least 170°F for water and glycol solution systems operating 140°F and less.
 - e. Maximum temperature rating of at least 250°F for water and glycol solution systems operating above 140°F and up to 180°F.
- C. Solder Joints:
1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA. Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform fillet around cup of fitting.
 2. Flux shall be non-acid type conforming to ASTM B813.
 3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use with 470°F melting point solder. Remove composition discs and all seals during soldering if not suitable for 470°F.
- D. Welded Joints:
1. Welding of all pipe joints, both as to procedures and qualification of welders, shall be in accordance with Section IX, ASME "Boiler & Pressure Vessel Code" unless local codes take precedence.
 2. Furnish certificates qualifying each welder to the Owner's Representative prior to start of work.
 3. The Owner's Representative reserves the right to require qualifying demonstration, at the Contractor's expense, of any welders assigned to the job.
 4. Ends of pipe and fittings to be joined by butt-welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
 5. Backing rings shall be used for all butt weld joints 3" pipe size and over and for all sizes where operating pressure is over 200 psig and/or temperature is over 400°F. Backing rings shall be of the material being welded.

END OF SECTION 23 21 00

SECTION 23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All pumps except where integral with a manufactured piece of equipment.
- B. Pump controls where self-contained.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.
- C. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.
- D. Submit motor data indicating compliance with Section 23 05 13.

PART 2 - PRODUCTS

2.1 PUMPS - GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction shall permit complete servicing without breaking piping or motor connections.
- C. Pumps shall operate at 1750 rpm unless specified otherwise.
- D. Pump connections shall be flanged, whenever available.
- E. Heating pumps shall be suitable for 225°F water.
- F. Motors shall comply with Section 23 05 13.
- G. Pump impellers shall not have smaller diameters than those scheduled. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 IN-LINE PUMP

- A. Type: Centrifugal, single stage, close coupled in-line, back pullout design, suitable for horizontal or vertical operation.
- B. Casing: Cast iron, rated for greater of 125 psi or 1.5 times actual working discharge pressure, flanged suction and discharge with gauge ports.
- C. Impeller: Bronze or stainless steel, fully enclosed, dynamically balanced, keyed to shaft and secured with locknut.
- D. Shaft: Steel or stainless steel.
- E. Seals: Carbon rotating against a stationary ceramic seat.
- F. Acceptable Manufacturers: Bell & Gossett, Grundfos.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturer's recommendations.
2. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger pump suction and discharge pipes. Allow a minimum of 18" clearance for removal of suction diffuser.
3. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
4. For pumps not powered by a VFD, trim impeller to meet maximum operating conditions. Coordinate final trimmed diameter with Testing, Adjusting, and Balancing Contractor.
5. Install on vibration isolators as scheduled on drawings.

B. In-Line Pumps:

1. Support in-line pumps individually so there is no strain on the piping. Install with a minimum of five diameters of straight pipe on pump suction and discharge.

END OF SECTION 23 21 23

SECTION 23 23 00 - REFRIGERATION PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping and Pipe Fittings
- B. Moisture and Liquid Indicators
- C. Check Valves
- D. Pressure Relief Valves
- E. Filter-Driers
- F. Suction Filters
- G. Solenoid Valves
- H. Expansion Valves
- I. Receivers
- J. Suction Accumulators

1.2 QUALITY ASSURANCE

- A. Remanufactured specialties are not acceptable.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labels in place.
- B. Protect piping and specialties from entry of foreign material by leaving caps and plugs in place until installation.

PART 2 - PRODUCTS

2.1 PIPING

- A. Design Pressure: 450 psig.
 - 1. Maximum Design Temperature: 250°F.
- B. Piping - 4" and under.
 - 1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal designation.
 - 2. Joints: Brazed with silver solder.
 - 3. Fittings: Wrought copper solder joint, ANSI B16.22.
 - 4. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen, plugged and tagged by manufacturer "for refrigeration service". During brazing operations, continuously purge the interior of the pipe with nitrogen to prevent oxide formation.

2.2 MOISTURE AND LIQUID INDICATORS

- A. UL listed, with copper, brass, or copper-plated steel body, flared or solder ends, extended fittings in units up to at least 1-1/8" to allow brazing without removing the cartridge, sight glass, color coded paper moisture indicator that is replaceable without breaking piping connections for units up to 1-1/8" size, and plastic cap; maximum working pressure of 500 psi, and maximum temperature of 200°F. Sporlan, Henry Valve Company, Alco Valve.

2.3 VALVES

- A. BA-14: Refrigerant Ball Valve: 3/8" thru 3-1/8", 500 psi, -40°F to +300°F, full-port up to 2-1/8" size, blow-out proof, PTFE seals, brass ball with equalizing orifice, visible position indication, seal cap, extended copper connections, replaceable stem seals, compatible with all CFC, HCFC, and HFC refrigerants. Henry Valve Company, Superior Valve, Alco Valve.

2.4 CHECK VALVES

- A. CK-10: 1/4" thru 3-5/8", 500 psi, globe or angle pattern, brazed, brass body, cleaned-dried-plugged and tagged at factory for refrigerant service. Henry Valve Company, Mueller, Wolf-Linde.

2.5 PRESSURE RELIEF VALVES

- A. RV-5: Straight Thru or Angle Type: Brass body and disc, Teflon seat, factory sealed and stamped with ASME UV and National Board Certification NB; selected to ANSI/ASHRAE 15.

2.6 FILTER-DRIERS

- A. Replaceable Cartridge Angle Type: ANSI/AHRI 710, UL listed, brass or epoxy-coated steel shell, molded desiccant high water capacity filter core(s); maximum working pressure of 500 psi; maximum temperature of 275°F; maximum pressure drop of 3 psi with R410a or 1.5 psi with R134a at system flow rate.
- B. Permanent Straight Thru Type: ANSI/AHRI 710, UL listed, steel shell with molded desiccant filter core, maximum working pressure of 500 psi, maximum pressure drop of 3 psi with R410a or 1.5 psi with R134a at system flow rate.

2.7 SUCTION FILTERS

- A. Replaceable Cartridge Angle Type: UL listed for 500 psi up to 2-18" size, and 400 psi for larger sizes, steel shell that passes 1000 hour salt spray test with copper fittings, replaceable pleated filter element(s); maximum pressure drops of 3 psi with R410a or 2 psi with R134a at system flow rate, capable of accepting molded desiccant core for cleanup after compressor burnout, access valve in the removable end plate. Install with side refrigerant inlet.

2.8 SOLENOID VALVES

- A. Valve: AHRI 760; pilot operated; copper or brass body and internal parts; synthetic seat; stainless steel stem and plunger assembly; extended solder ends to permit installation without disassembly; maximum working pressure of 500 psi; normally closed. Maximum pressure drop at system flow of 5 psi for R410a and 3 psi for R134a.
- B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, surge protector and color-coded lead wires, integral junction box, Class F temperature rated, ANSI/UL 429.

2.9 EXPANSION VALVES

- A. Angle or Straight Thru Type: ANSI/AHRI 750; materials suitable for system refrigerant, external equalizer, adjustable super heat setting, balanced port design, suitable for horizontal or vertical installation, with replaceable capillary tube and remote sensing bulb.
- B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10°F super heat. Select to avoid being undersized at full load or excessively oversized at part load.

2.10 RECEIVERS

- A. All receivers shall have capacity to hold the entire refrigerant charge when 90% full at 90°F per ASHRAE 15-78.
- B. 6" and Smaller Internal Diameter: ANSI/AHRI 495, UL listed, steel or copper, brazed; 450 psi working pressure, with tappings for inlet, outlet, and relief valve or fusible plug.
- C. Over 6" Internal Diameter: ANSI/AHRI 495, welded steel; ASME U or UM stamped for 400 psi, with tappings for inlet, outlet and pressure relief valve.

2.11 SUCTION ACCUMULATORS

- A. All accumulators shall have capacity to hold 50% of the refrigerant charge when 90% full at 90°F per ASHRAE 15-78, pressure drop equivalent to under 0.5°F at peak capacity, a finish that survives a 500 hour salt spray test, vertical design with dip tube and screened oil inlet orifice, and a hot gas boil-out coil to evaporate liquid refrigerant.
- B. 6" and Smaller Internal Diameter: ANSI/AHRI 495, UL listed, steel or copper, brazed; 400 psi pressure rating, with tappings for inlet, outlet, and pressure relief valve or fusible plug.
- C. Over 6" Internal Diameter: ANSI/AHRI 495, welded steel, ASME U or UM stamped for 450 psi, with tappings for inlet, outlet and pressure relief valve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.

3.2 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.
- F. Group piping whenever practical at common elevations and locations. Slope piping 1% in direction of oil return.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Provide access doors for concealed valves and specialties.

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- J. Where pipe support members are welded to structural building frame, brush clean, and apply zinc rich primer to welding.
 - K. Insulate piping and equipment; per Section 23 07 19 and Section 23 07 16.
 - L. Provide external equalizer piping on expansion valves, and locate expansion valve sensing bulb immediately downstream of evaporator on suction line. Connect distributor to expansion valve outlet.
 - M. Install flexible connectors parallel to the shafts of compressors.
 - N. Fully charge system with refrigerant after testing.

3.3 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied identification sufficient to determine their conformance with specified requirements.
- C. Exercise care at all times to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.
- D. During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items designed for this purpose.
- E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings.
- F. Cut all pipe to exact measurement and install without springing or forcing.

3.4 APPLICATION

- A. Provide solenoid valves in liquid lines of systems, in oil bleeder lines to stop flow of oil and refrigerant into the suction line when system shuts down, and in hot gas bypass lines, as applicable.
- B. Provide refrigerant charging valve connections.
- C. Provide replaceable cartridge filter-driers, with three-valve bypass assembly and suction filters without bypass assembly.

3.5 FIELD QUALITY CONTROL AND LEAK TESTING

- A. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.
- B. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

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- C. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

 - D. Submit signed documentation of pressure testing results. Coordinate requirements with commissioning agent.

END OF SECTION 23 23 00

SECTION 23 25 00 - CHEMICAL (WATER) TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Treatment for Closed Systems (Water).
- B. Chemical Feed Equipment.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Include system schematics, equipment locations, and controls schematics.
- C. Submit product data indicating chemicals and equipment.
- D. Submit manufacturer's installation instructions.
- E. Submit reports indicating start-up of treatment systems is completed and operating properly. Include reports indicating analysis of system water after cleaning and after treatment.

1.3 EXTRA STOCK

- A. Provide clean cartridges or bags in all bypass (pot) feeders with filters.
- B. Provide two complete sets of replacement cartridges or filters for each bypass (pot) feeder with filters and installed. Deliver to Owner at job site.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include data on pumps, agitators, and other equipment including spare parts lists, procedures, and treatment programs.
- C. Include step-by-step instructions on test procedures including target concentrations and test frequencies.
- D. Include list of treatment chemicals and the MSDS for all chemicals.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

1.6 REGULATORY REQUIREMENTS

- A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical systems, and for discharge to public sewage systems.
- B. Provide only chemicals approved for use and disposal by local authorities. Contact the Architect/Engineer if any specified chemicals are prohibited.

1.7 MAINTENANCE SERVICE

- A. Provide the following services to assist the owner in setting up and maintaining chemical treatment systems for one year from Date of Substantial Completion:
1. Provide technical service visits to perform field inspections and make water analysis on site. Visits shall be before heating season and near end of warranty period. Detail findings in writing on proper practices, chemical treating requirements, and corrective actions needed. Submit copies of the field service report after each visit to the Owner and to the Mechanical Contractor. Any problems related to the operation of the chemical treatment program shall be reported to the Architect/Engineer.
 2. Provide laboratory and technical assistance services for warranty period.
 3. Include one (1) hour training course for operating personnel, instructing them on installation, care, maintenance, testing, and operation of water treatment systems. Arrange course at start-up of systems.
 4. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program, and make recommendations in writing based upon these inspections.
 5. Provide sufficient chemicals for treatment and testing during warranty period.
- B. The Chemical Treatment Subcontractor shall be responsible for assisting the Mechanical Contractor by adding the chemical solutions required for cleaning each piping system. During the remainder of the warranty period, the Chemical Treatment Subcontractor will be responsible for adding chemicals and doing other work related to the operation of system. The Chemical Treatment Contractor shall make periodic tests of the chemical treatment program as called for above and recommend changes to Owner when needed.

1.8 WATER ANALYSIS

- A. Sample feedwater to determine appropriate chemical treatment. Contact the Architect/Engineer if test indicates treatment required is different than that specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nalco.
- B. Betz.
- C. America's Best Water Treaters.
- D. H-O-H Chemicals, Inc.
- E. Industrial Water Management.
- F. Garratt-Callahan Company.
- G. Lakeland Chemical Specialties, Inc.
- H. Butler Chemical Company.

2.2 MATERIALS

- A. Closed System Treatment (Water):
1. Provide one bypass feeder on each system. Install inlet, outlet and drain valves, and necessary piping.
 2. Provide a 3/4" water meter in the domestic cold water line that provides makeup water to steam systems.

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3. Proprietary blend containing the following items:
 - a. Corrosion Inhibitors for Heating Water System: Sodium nitrite-borax or molybdate with added inhibitors such as mercaptobenzothiazole, sodium tolytriazole, or phenyltriazole to protect copper and brass and minimize dielectric pitting of steel. Maintain 1,000 ppm nitrite or 100 ppm molybdate. Adjust borax content to keep correct pH for type of system (mainly steel or mainly copper).
 - b. Scale Inhibitor: Organic phosphonates such as aminomethylene-phosphonate; phosphonates such as hydroxyethylidenediphosphonate or polyamino-substituted phosphonates; or synthetic polymers such as low-molecular-weight polyacrylates, poly-methacrylates and polyacrylanides. Inorganic phosphates are not acceptable. Maintain residual concentration as recommended by the manufacturer.

2.3 EQUIPMENT

- A. Bypass (Pot) Feeder: 5.0 gal; quick-opening cap with 3-1/2" minimum diameter opening and opening wrench, drain valve, air cock, working pressure of 200 psig at 200°F, 20 to 25 micron cartridge or bag filter. Acceptable Manufacturers: Griswold.
- B. Water Meter: (Steam systems with Bypass feeder) Positive displacement type meter with bronze housing. 3/4" meter size. Meter to handle 1/2 - 30 GPM.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install bypass (pot) feeder with top approximately 36" above the floor.
- C. Coordinate with Contractor to provide temporary metering capabilities during system fill to determine overall system volume.

END OF SECTION 23 25 00

SECTION 23 31 00 - DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized Ductwork
- B. Aluminum Ductwork
- C. Ductwork Reinforcement
- D. Ductwork Sealants
- E. Rectangular Ductwork - Single Wall
- F. Round and Flat Oval Ductwork - Single Wall
- G. Exposed Ductwork (Rectangular, Round, or Oval)
- H. Flexible Duct
- I. Leakage Testing
- J. Ductwork Penetrations
- K. Duct Cleaning
- L. Painting

1.2 DEFINITIONS

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.

1.3 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 23 05 00 for required duct systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.
- B. Duct drawings shall be at 1/4" minimum scale complete with the following information:
 - 1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
 - 2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
 - 3. Location and size of all duct access doors.
 - 4. Room names and numbers, ceiling types, and ceiling heights.
 - 5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.
- C. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be obtained from the Architect.

PART 2 - PRODUCTS

2.1 GALVANIZED DUCTWORK

A. General Requirements:

1. Duct and reinforcement materials shall conform to ASTM A653 and A924.
2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
3. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
4. Ductwork reinforcement shall be of galvanized steel.
5. Ductwork supports shall be of galvanized or painted steel. Slip cable hangers are acceptable. Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.
6. All fasteners shall be galvanized or cadmium plated.

2.2 DUCTWORK REINFORCEMENT

A. General Requirements:

1. All reinforcement shall be external to the duct except that tie rods may be used with the following limitations.
 - a. Ducts must be over 18" wide.
 - b. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods installed.
 - c. Tie rods must not exceed 1/2" diameter.
 - d. Manufacturer of tie rod system must certify pressure classifications of various arrangements, and this must be in the shop drawings.

2.3 DUCTWORK SEALANTS

- A. One part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M.
- B. Joint sealers shall meet the volatile organic compound (VOC) limits of U.S. Green Building Council LEED credit EQ 4.1, Low-Emitting Materials - Adhesives & Sealants (follow the latest edition at the time of bidding or as referenced in these specifications).
- C. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include: Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

2.4 RECTANGULAR DUCT - SINGLE WALL

A. General Requirements:

1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
2. Transitions shall not exceed the angles in Figure 4-7.

B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:

1. All ducts shall be cross-broken or beaded.
2. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the drawings. Vanes shall be as follows:
 - a. Type 1:
 - 1) **Description:** Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4" blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by runner manufacturer. Runners shall have extra long locking tabs. C-value independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or equal.
 - 2) **Usage:** Limited to 3,000 fpm and vane lengths 36" and under.
 - b. Type 2:
 - 1) **Description:** Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.
 - 2) **Usage:** No limits other than imposed by the manufacturer. Provide intermediate support for vanes over 48" long.
 - c. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.
 - d. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must be radius type.
 - e. Omitting every other vane is prohibited.
3. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream from the inside radius of radius elbows.
4. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.
5. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

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6. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between fans and TAB devices.
 7. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
 8. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall extend past the liner before being folded over.
 9. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class, and must be less than 6" in length.
 10. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
 - a. Apply sealant to all inside corners. Holes at corners are not acceptable.
 - b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.
 11. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards for sheet and joint deflection at the specified pressure class.
 - a. Apply sealant to all inside corners. Holes at corners are not acceptable.
 - b. Flanges shall be 24-gauge minimum (not 26 gauge).
 - c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other manufacturers must submit test data and fabrication standards and receive Architect/Engineer's approval before any fabrication begins.

2.5 ROUND AND FLAT OVAL DUCTWORK - SINGLE WALL

- A. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.
- B. Snap lock seams are not permitted.
- C. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.
- D. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
- E. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.

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- F. Ductwork shall be suitable for velocities up to 5,000 fpm.
 - G. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
 - H. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
 - I. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
 - J. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.
 - K. Transverse Joint Connections:
 - 1. Crimped joints are not permitted.
 - 2. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
 - 3. Ducts and fittings larger than 36" shall have flanged connections.
 - 4. Secure all joints with at least 3 sheet metal screws before sealing.
 - 5. Slide-on flanges as manufactured by Ductmate Industries, Accuflange, or Sheet Metal Connectors are acceptable. Self-sealing duct systems are also acceptable (Lindab, Ward "Keating Coupling").

2.6 EXPOSED DUCTWORK (RECTANGULAR, ROUND, AND FLAT OVAL)

- A. The following applies to all ductwork exposed in parking garages and the Sallyport in addition to requirements noted above:
 - 1. Provide extra shipping protection. Use Cardboard or other protective means to prevent dents and deformed ends.
 - 2. Provide cardboard or other means of protection during field fabrication. Protect from scratches. Provide stiffeners to retain shape during fabrication.
 - 3. Remove all identification stickers and thoroughly clean exterior of all ducts.
 - 4. Locate fitting seams on least visible side of duct.
 - 5. Provide exterior finish suitable for field painting without further oil removal.
 - 6. Provide ramp-type internal joint couplings. Provide bead of sealant around the inside of the duct about 1/2" from the end of the duct. Slide-on flanges as manufactured by Ductmate Industries, Accuflange or Sheet Metal Connectors are acceptable. Self-sealing duct system is also acceptable (Lindab, Ward "Keating Koupling").
 - 7. The system shall be free of visible dents and scratches when viewed from normal occupancy.
- B. Alternate manufacturers, including shop fabricated duct, must be reviewed before installation. The following information is required:
 - 1. Metal gauge of duct and fittings.
 - 2. Fitting type and construction.
 - 3. Type and size of reinforcement.

2.7 FLEXIBLE DUCT

- A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.
- B. Flame Spread/Smoke Developed: Not over 25/50.
- C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.
- D. Inner liner shall be airtight and suitable for 6" WC static pressure through 10" diameter and shall be airtight and suitable for 4" WC static pressure 12" through 16" diameter. Outer jacket shall act as a vapor barrier only with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0 ft²*°F*hr/Btuh. Temperature range of at least 0-180°F. Maximum velocity of 4,000 fpm.
- E. Usage:
 - 1. Connections to air inlets and outlets. Do not exceed 3'-0" in length.
- F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.
- G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide openings in ducts for thermometers and controllers.
- B. Locate ducts with space around equipment for normal operation and maintenance.
- C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms
- D. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork. Supply ductwork shall be free of construction debris, and shall comply with level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- E. Repair all duct insulation and liner tears.
- F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.
- G. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.
- H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.
- I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.

- J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.
- K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible. No hanger penetrations of insulation vapor barrier are allowed. Refer to 23 07 13 for requirements.
- L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.

3.2 DUCTWORK APPLICATION SCHEDULE

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS†	INSULATION (Refer to Section 23 07 13 for insulation types)
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Rectangular	+3"	A	1-1/2" thick Type A
Supply Duct from Fan to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Round	+3"	A	1-1/2" thick Type A
Supply Duct from Fan to Terminal Air Boxes	Galvanized Sheet Metal w/Slide-On Flange System or Formed-on Flanges	+3"	A	1-1/2" thick Type A
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	+2"	A	1-1/2" thick Type A.
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	+2"	A	1-1/2" thick Type A.
Return Duct	Galvanized Sheet Metal	-2"	A	None
Exhaust Duct from Fan to Terminal Air Boxes	Galvanized Sheet Metal	-3"	A	None
Exhaust Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	-2"	A	None
Exhaust Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	-2"	A	None
Outside Air Intake from Louver to ERU/AHU	Galvanized Sheet Metal	-2"	A	2" thick Type B
Mixed/Make-up Air Duct	Galvanized Sheet Metal	-2"	A	2" thick Type B
Tempered Outdoor between ERU and AHU	Galvanized Sheet Metal	+2"	A	2" thick Type B
Relief Air Louver to Relief Damper	Galvanized Sheet Metal	+2"	A	2" thick Type B
Transfer Ducts	Galvanized Sheet Metal	-1/2"	---	1" thick Type C
Ductwork Accessories (Fabric Flex Connectors, Equipment Flanges, etc.)	---	---	---	1-1/2" thick Type A
All Terminal Air Box/ Reheat Coil Headers and Duct Mounted Coil Headers	--	--	---	1-1/2" thick Type A
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual				

3.3 DUCTWORK SEALING

A. General Requirements:

1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.

B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jams, duct, plenum, and casing abutments to building structures.

3.4 TESTING

A. Duct – Less than 2" WG (positive or negative):

1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test Manual for Seal Class A.
2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
4. Seal ducts to bring the air leakage into compliance.
5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.
6. Submit signed documentation of leakage testing results within two weeks of testing..

B. Duct - 2" WG and Above (positive or negative):

1. A minimum of 25% of interior ductwork and all exterior ductwork shall be tested. The Owner or designated representative shall select the sections to be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

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- C. Test procedure shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:
1. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.
 2. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
 3. All joints shall be felt by hand, and all discernible leaks shall be sealed.
 4. Totalling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.
 5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.
 6. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
 7. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
 8. The required leakage class for Seal Class A, both round and rectangular ducts, shall be 4.
 9. Positive pressure leakage testing is acceptable for negative pressure ductwork.

3.5 DUCTWORK PENETRATIONS

- A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being penetrated with Architect/Engineer.
- C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms.

3.6 PAINTING

- A. Paint interior of ducts black within twice the largest duct dimension of inlets and outlets where interior of duct is visible.
- B. Paint bottom of ducts black within twice the largest duct dimension where a duct is routed above an unducted perforated grill and the duct is visible.

END OF SECTION 23 31 00

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual Volume Dampers.
- B. Fire Dampers.
- C. Fabric Connectors.
- D. Drip Pans.
- E. Duct Access Doors.
- F. Duct Test Holes.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

- A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.
- B. Fabricate single blade dampers for duct sizes to 9-1/2 x 30 inches.
- C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes 12" x 72". Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
- D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide molded synthetic or oil-impregnated nylon or sintered bronze bearings.
- E. Provide locking quadrant regulators on single and multi-blade dampers.
- F. On insulated ducts, mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
- G. If blades are in open position and extend into the main duct, mount damper so blades are parallel to airflow.

2.2 DYNAMIC MULTIPLE BLADE FIRE DAMPERS (FD)

- A. Furnish and install fire dampers in ducts, where shown on the drawings, at the point where they pass through a fire wall or a floor and in all other locations required by the local fire department, The National Fire Protection Association's Pamphlet No. 90A and all other applicable codes.
- B. Fire dampers shall be UL 555 listed for 1-1/2 hour fire resistance unless noted otherwise, dynamic rated at 2,000 fpm and 4" WC, with the blades located in the air stream.
- C. Where dampers are located in aluminum or stainless steel duct, provide stainless steel dampers.
- D. Blades shall be airfoil shaped, double skin construction with stainless steel bearings.
- E. Fire dampers shall be held open by a fusible link rated at 165°F unless otherwise called for on the drawings or by local codes.

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- F. Dampers shall be installed in sleeves of sufficient thickness to permit rigid duct connections. The sleeve shall be a minimum of 16 gauge for dampers up to 36" wide by 24" high and 14 gauge for dampers exceeding 36" wide by 24" high. Damper sleeve shall not extend more than 6" beyond the firewall or partition unless damper is equipped with a factory installed access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the factory installed access door.
 - G. Locate access door in the ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high, reading "FIRE DAMPER".

2.3 FABRIC CONNECTORS

- A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer of fan or motor vibration.
- B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.
- C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and resistant to acids, alkalies, grease and gasoline, and shall be noncombustible.
- D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that has a negative pressure, the length shall not exceed 2" in length.
- E. All corners shall be folded, sealed with mastic and stapled on 1" centers.
- F. Fabric connectors shall not be painted.
- G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least one duct diameter from the fan to prevent inlet turbulence.
- H. Acceptable Materials: Durodyne MFN-4-100, Vent Fabrics, Inc. "Ventglas", or Proflex PFC3NGA.
- I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be hypalon in lieu of neoprene.
- J. Acceptable Materials: Durodyne "Duralon MFD-4-100", Vent Fabrics, Inc. "Ventlon", or Proflex PFC3HGA.

2.4 DRIP PANS

- A. Install drip pans under all rooftop exhaust fans, intake hoods, exhaust hoods and other roof penetrations that do not have ductwork below them to intercept dripping water.
- B. Drip pans shall be 22 gauge minimum cross-broken or reinforced sheet metal with 2" welded upturned lips.
- C. Pans shall extend 6" in all directions beyond the opening and shall have the top of the lip located 25% of the maximum throat dimension below the opening.
- D. Insulate interior of drip pan with 1" thick elastomeric foam insulation. Adhere foam to drip pan with standard foam adhesive.

2.5 DUCT ACCESS DOORS

- A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.
- B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment requiring service inside the duct.

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- C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.
 - D. Access doors with sheet metal screw fasteners are not acceptable.
 - E. Minimum size for access doors shall be 24" x16" or full duct size, whichever is less.
 - F. Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers. This will typically require one access door on the bottom and one access door on an accessible side of the duct for sizes 12x12 and smaller.

2.6 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install accessories in accordance with manufacturer's instructions.
2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
3. Coordinate and install access doors provided by others.
4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
5. Grease duct access doors shall be installed per approvals from manufacturer's ICC-ES Evaluation Report.
6. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.
3. Grease duct volume dampers shall be continuously welded to duct and/or hoods so that system is liquidtight.

C. Fire Damper:

1. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves and duct connections.

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2. Provide ceiling access doors for fire dampers. Coordinate location with the Architect/Engineer.
 3. Demonstrate resetting of fire dampers to authorities having jurisdiction and Owner's representative.
 4. At fire dampers where duct is externally insulated, the exterior duct wrap shall extend up to the wall.

D. Drain Pan:

1. Drain pans shall be installed per ASHRAE 62.1.
 - a. All drain pans shall be field tested under normal operating conditions to ensure proper drainage.
 - b. Field testing of drain pans is not required if units with factory installed drain pans have been certified (attested in writing) by the manufacturer for proper operation when installed as recommended.

END OF SECTION 23 33 00

SECTION 23 34 13 - AXIAL FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Vane Axial Fans.
- B. Mixed Flow Fans.

1.2 QUALITY ASSURANCE

- A. Performance Ratings: Bear the AMCA Certified Rating Seal - Air Performance.
- B. Fabrication: Conform to AMCA 99.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include data on all axial fans and accessories, fan curves with specified operating points clearly plotted, and sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories.
- B. Submit performance data for adjustable axial fan blades for at least five blade settings, including maximum.
- C. Submit operation and maintenance data. Include instructions for lubrication, motor and drive replacement and spare parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

PART 2 - PRODUCTS

2.1 VANE AXIAL FAN

- A. In-line vane axial type, suitable for up to 3" static pressure, non-overloading.
- B. Direct Drive Arrangement.
- C. Externally mounted open drip-proof, ball bearing motor. Motor shall be minimum 1/3 HP.
- D. Aluminum air foil blades, heliarc welded to aluminum hub. Statically and dynamically balanced.
- E. Discharge straightening vanes welded in place.
- F. Aluminum housing with inlet and outlet flanges.
- G. Regreasable bearings rated for 40,000 hour B-10 life at the design operating point, with lubrication lines extended outside of the housing.
- H. Suitable for horizontal or vertical mounting unit shall include mounting brackets.
- I. Acceptable Manufacturers: Aerovent, Greenheck, Joy, or New York Blower.

2.2 MIXED FLOW FAN

- A. Mixed flow in-line fan with enclosure, connecting flanges, drives and motor.
- B. Wheel: Wheel shall be steel, non-overloading, high efficiency mixed-flow type. Contoured single thickness blades shall incorporate 3-D curvature for maximum efficiency across the entire surface of the blade. Blades shall be continuously welded to the backplate and inlet shroud. Hubs shall be keyed and securely attached to the fan shaft. Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
- C. Provide fan mounted in either vertical or horizontal arrangement and ceiling or floor mounted as shown on the drawings.
- D. Direct Drive Arrangement.
- E. The motor shall be mounted external to the fan on an adjustable base. Motor shall incorporate a universal mounting system that allows for field rotation of the motor in 90 degree increments. Refer to Section 23 05 13 for motor requirements.
- F. Fans shall have self-aligning, grease-packed, pillow block bearings with a grease seal to prevent loss of lubricant and exclude dirt. Bearings shall absorb all the fan thrust. Extend grease fittings outside the fan. Bearings rated for 200,000 B-10 life at specified operating point
- G. Provide hanger rods to mount the fans complete with vibration isolators as scheduled in Section 23 05 48.
- H. Fans shall be statically and dynamically balanced.
- I. Provide inlet and outlet screens where unit is not attached to ductwork or does not have inlet or outlet cones. Attach screens directly to the fan.
- J. Acceptable Manufacturers: Greenheck QEI, Twin City QSL.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fans have been test run under observation.
- B. Install flexible connections between axial fans and ductwork. Ensure metal bands of connectors are parallel with minimum 1" flex between ductwork and axial fan while running.

END OF SECTION 23 34 13

SECTION 23 34 16 - CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. In-line Centrifugal Fans.

1.2 QUALITY ASSURANCE

- A. Performance Ratings: Bear the AMCA Certified Rating Seal - Air Performance.
- B. Fabrication: Conform to AMCA 99.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include all centrifugal fans and accessories. Provide fan curves with specified operating point clearly plotted. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories.
- B. Submit operation and maintenance data. Include instructions for lubrication, motor and drive replacement, and spare parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FAN

- A. Galvanized steel construction with stainless steel or cadmium plated fasteners and galvanized steel belt guard.
- B. Backward inclined, non-overloading, all aluminum wheel and hub. Dynamically and statically balanced.
- C. Cast iron, adjustable pitch sheaves. V-belt drive sized for 1.5 of maximum horsepower. Operating point near center of adjustment range.
- D. Regreasable bearings rated for 40,000 hour B-10 life at specified operating point. Extend lubrication lines outside of housing.
- E. Steel mounting brackets suitable for any mounting position.
- F. Motor per the drawings and Section 23 05 13. Minimum 1/3 HP motors for all fans.
- G. Factory installed and wired disconnect switch.
- H. Acceptable Manufacturers: Jenco Fan, Carnes, Penn or Greenheck.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
2. Install flexible connections between fan and ductwork. Install metal bands of connectors parallel with minimum 1" flex between ductwork and fan while running.
3. Provide safety screen where inlet or outlet is exposed. Screens shall meet OSHA regulations for size of openings.

END OF SECTION 23 34 16

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Duct Variable Air Volume Terminal Box.

1.2 REFERENCES

- A. NFPA 70 - National Electric Code.
- B. NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- C. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit shop drawings indicating configuration, general assembly, and materials used in fabrication.
- C. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate airflow, static pressure, and NC designation.
- D. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of one to 4 inch WG.
- E. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists.
- C. Include directions for resetting constant volume regulators.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CONSIDERATIONS (THIS APPLIES TO ALL UNITS)

- A. All units shall have noise data certified in accordance with AHRI Standard 885-98 with 5/8" 20-lb. density mineral fiber ceiling tile and shall not produce space noise values over NC-35 due to radiated and airborne noise combined.

2.2 SINGLE DUCT VARIABLE AIR VOLUME TERMINAL BOX

- A. 18 gauge aluminum housing with internal components of aluminum and stainless steel.
- B. Teflon bearings at moving parts and Neoprene seals.
- C. Valve configuration for smooth variations in airflow.
- D. Pressure independent operation without means of external monitoring devices. Box shall maintain constant volume at all flow rates regardless of changes in upstream or downstream static pressure.

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- E. Box shall be fully wrapped with elastomeric insulation.
 - F. Box shall be capable of controlling within 5% accuracy.
 - G. Unit shall have Belimo actuator.
 - H. Unit shall fail in last position.
 - I. Refer to control diagrams and notes on control drawings for complete sequence of control.
 - J. Acceptable Manufacturers: Accutrol.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Maintain minimum working clear space for all electrical connections in accordance with NFPA 70, National Electrical Code.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure. Do not support from adjacent ductwork.
- E. Where boxes are located adjacent to a wall or joist, the damper motors and control valves shall be located on the side of the box away from the wall or joist to permit easy access.

3.2 ADJUSTING

- A. All boxes shall be set to the cfm shown on the drawings. TCC shall be responsible to field recalibrate all boxes that are not set correctly.

END OF SECTION 23 36 00

SECTION 23 37 00 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grilles and Registers.
- B. Square Stepdown Cone Diffusers.
- C. Linear Diffusers.
- D. Linear Diffuser Supply Plenum.
- E. Louvers.

1.2 QUALITY ASSURANCE

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.
- C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00.
- B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.
- D. Submit manufacturer's installation instructions.

1.4 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.
- B. Conform to ASHRAE 90.1.

PART 2 - PRODUCTS

2.1 GRILLES AND REGISTERS

- A. Reference to a grille means an air supply, exhaust or transfer device without a damper.
- B. Reference to a register means an air supply, exhaust or transfer device with a damper.
- C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- E. The capacity and size of the unit shall be as shown on the drawings.

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- F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.
 - G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles and registers.
 - H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic pivots are not acceptable.
 - I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles and registers shall have staked corners.
 - J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the register.
 - K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
 - L. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.

2.2 SQUARE STEPDOWN CONE DIFFUSERS

- A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly throughout the conditioned space.
- B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets are not acceptable for connection to flexible ducts.
- C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- D. The capacity and size of the unit shall be as shown on the drawings.
- E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10^{-12} watts with a 10 dB room effect.
- F. Diffusers shall be drop face construction.
- G. Diffuser shall be entirely constructed of stamped panel and a minimum of three stepdown diffusion cones.
- H. Stepdown cones shall be mechanically fastened to panel with metal fasteners. Diffuser stepdown cones glued, fastened with plastic clips, or otherwise attached to face panel will not be acceptable.
- I. Each stepdown cone shall be one piece stamped construction. The cones shall be removable for cleaning.
- J. Diffusers shall be constructed of minimum 24 gauge steel.
- K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.
- L. Linear Bar Grille Diffusers:
 - 1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-round transition if required.
 - 2. The capacity and size of the unit shall be as shown on the drawings.

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3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10⁻¹² watts with a 10 dB room effect per ANSI/ASHRAE 70.
 4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings prior to submitting shop drawings.
 5. Provide with concealed fasteners for installation in the field.
 6. Linear bar diffusers and mounting frames shall be furnished as one piece up to 6' in length. Provide auxiliary support per manufacturer's recommendations for slot diffusers greater than 4' in length.
 7. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to each bar grille. Balancing dampers shall not be installed in supply plenum or at air outlet unless otherwise indicated on the drawings.
 8. Diffuser length and width, bar width, and spacing between bars shall be as shown on the drawings.
 9. Provide insulated plenum for each linear diffuser. Refer to linear diffuser supply plenum section for details.
 10. Acceptable Manufacturers: Tuttle & Bailey 4000, Carnes CC;CT;CW, Krueger 1500/1600, Price LB, Nailor 4900, Titus CT, Metalaire 2000.

2.3 LOUVERS - BY GENERAL CONTRACTOR

- A. Louvers shall be provided and installed by the General Contractor.
- B. Coordinate exact sizes and locations required for ductwork connections.
- C. Bird screen shall be on the outside of the louver.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 1. Install items in accordance with manufacturers' instructions.
 2. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
 3. Install diffusers to ductwork with air tight connections.
 4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
 5. Supply air diffusers in operating rooms (Class B and C surgery) shall be opened and cleaned before the space is used.

B. Volume Damper:

1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.

END OF SECTION 23 37 00

SECTION 23 40 00 - AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Filters and Filter Media.
- B. Activated Carbon Filters.
- C. Filter Frames.
- D. Filter Gauges.

1.2 QUALITY ASSURANCE

- A. Filter media shall be tested under ANSI/UL 900 and labeled.
- B. Provide all filters and filter banks by one manufacturer.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include data on media, performance, assembly and frames.

1.4 EXTRA STOCK

- A. Provide clean filters in all units at time of installation.
- B. Provide clean filters in all units at project final completion after all interior finishes are complete.
- C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

PART 2 - PRODUCTS

2.1 MEDIUM EFFICIENCY - DISPOSABLE

- A. Non-woven cotton fabric, pleated media, disposable type with welded wire grid support bonded to the filter media.
- B. Heavy duty, paper board frame with diagonal support members bonded to inlet and exit sides of each pleat. Bond frame to media periphery to eliminate air bypass.
- C. 4" thick media. Maximum initial resistance of 0.26" WG at 500 fpm face velocity.
- D. 25-30% efficiency and 90-92% arrestance per ASHRAE 52.1 or MERV 8 per ASHRAE 52.2.

2.2 80% EFFICIENCY - DISPOSABLE

- A. Non-woven cotton fabric, pleated media, disposable type with welded wire grid support bonded to the filter media.
- B. Heavy duty, paper board frame with diagonal support members bonded to inlet and exit sides of each pleat. Bond frame to media periphery to eliminate air bypass.
- C. 4" thick media. Maximum initial resistance of 0.20" WG at 500 fpm face velocity.
- D. 80% efficiency and 98% arrestance per ASHRAE 52.1 or MERV 13 per ASHRAE 52.2.

2.3 FILTER GAUGES

- A. Differential Pressure Gauge: Diaphragm actuated, nominal 3" round dial, glass filled nylon housing, polycarbonate lens, zero adjustment, 0-2" W.G. range, 5% of full scale accuracy.
- B. Accessories: Static pressure tips with integral compression fittings and 1/8" NPT plastic tubing.
- C. Acceptable Manufacturers: Dwyer "Minihelic II" 2-5000, Marshalltown Instrument "Series 85C".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturers' instructions.
- B. Seal filter media to prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan systems without filters.
- D. Install static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and calibrate. Every filter bank, including packaged units, shall have a filter gauge.
- E. Install four (4) high efficiency filter test holes. Two upstream and two downstream, at all high efficiency filter banks in air handling units and ductwork (85% efficiency and higher). Coordinate location of test holes with Owner.

END OF SECTION 23 40 00

SECTION 23 52 16 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Boilers.
- B. Controls and Boiler Trim.
- C. Hot Water Connections.
- D. Fuel Burning System and Connection.
- E. Vent Connection.
- F. Boiler Vent Flue.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with at least three years documented experience.
- B. Provide factory authorized start-up service by manufacturer's agent.
- C. Conform to ANSI/ASME SEC 4 and ANSI/AGA Z21.13 for construction of boilers.
- D. Boiler Units: AGA certified, UL listed and ASME certified.
- E. Installation shall meet the requirements of ASME CSD-1, including remote emergency shutdown switches for boilers, applicable gas train, individual venting of gas regulators, and repackable shutoff valves at all boilers.
- F. Conform to ASHRAE 90.1.

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00.
- B. Submit product data indicating general assembly, components, controls, safety controls, and wiring diagrams, and service connections.
- C. Submit manufacturer's installation instructions.
- D. Submit reports indicating condition and operation at start-up.
- E. Submit reports indicating specified performance and efficiency is met or exceeded.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

PART 2 - PRODUCTS

2.1 BOILERS

- A. Provide factory assembled, factory fire-tested, self-contained unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.
- B. Unit: Hot water, condensing type boiler with integral forced draft burner, burner controls, boiler trim, insulation and jacket.
- C. ASME allowable working pressure of 125 psig water.
- D. Provide two lifting eyes on top of boiler.
- E. Unit casing shall be a minimum of 16 gauge steel. Factory paint boiler, base, and other components with hard finish enamel.
- F. Porcelain enameled or stainless steel exhaust manifold with gravity drain and reservoir for condensate elimination.
- G. Boiler shall be intended for variable flow system.
- H. Acceptable Manufacturer: Lochinvar (Crest), Aerco International, Inc. (Benchmark).

2.2 HEAT EXCHANGER

- A. Condensing, fire tube design surrounded by water that is suitable for return water temperatures as low as 80°F. Heat exchanger shall be constructed of fully welded 316L stainless steel.
- B. Ten-year non-prorated warranty against leakage due to thermal shock or corrosion.

2.3 BOILER FLUE

- A. The boiler manufacturer shall furnish all vent flue and intake piping, fittings, dampers, and accessories as required to properly vent the equipment. Vent piping shall be UL listed for use IV appliances with operating temperatures of up to 480°F and shall be stainless steel materials.

2.4 HOT WATER BOILER TRIM

- A. Provide ASME safety relief valve set at 50 psi maximum.
- B. Provide low water cut-off with manual reset to automatically prevent burner operation whenever boiler water falls below safe level.
- C. Provide operating temperature controller to control burner operation to maintain boiler water temperature, as determined by a remote 4-20 mA signal from building DDC system or boiler controller.
- D. Limit temperature controller to control burner to prevent boiler water temperature from exceeding safe system water temperature.
- E. Provide all trim required to meet ASME CSD-1. This includes, but is not limited to, gas train and all terminals and necessary relays for connection to remote shutdown switch(es) to disconnect all power to the burner controls.

2.5 FUEL BURNING SYSTEM

- A. General: Forced draft automatic burner integral with boiler designed to burn natural gas at 8.5" to 14" W.C. inlet pressure. Maintain fuel-air ratios automatically.

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- B. Gas Burner: Forced draft, power burner with interrupted spark ignition and flame sensor.
 - C. Include on unit complete gas train including gas safety shutoff valve conforming to CSD-1 requirements. Vent all gas valves to outdoors separately.
 - D. Burner to be modulating with a minimum turndown ratio of 5:1.

2.6 CONTROL PANEL

- A. The boiler system control panel shall include contacts for a trouble alarm to the DDC system. System shall include analog input from DDC system for boiler temperature setpoint control and digital input for boiler enable/disable.
- B. The boiler system control panel shall include gateway device for BACnet Communications. Coordinate final connections with temperature control contractor.
- C. The boiler control system shall modulate burner as required to maintain heating water temperature setpoint.
- D. The boiler manufacturer shall supply boiler isolation valve for each boiler. Boiler control panel shall open isolation valve when boiler is operating. At no time shall all isolation valves on the boilers be closed.
- E. Program relay to control ignition, starting and stopping of burner and provide both pre-combustion purge and post combustion purge. Burner to shut down in event of ignition, or main flame failure. Interlock to shut down burner upon combustion air pressure drop.
- F. Manual-automatic selector switch to permit automatic firing in accordance with load demand, or manual control of firing rate at fixed temperature.
- G. Panel to include indicating lights to show fault conditions of low water level, flame failure, fuel pressure, exhaust temperature, water temperature, or combustion air pressure. Mount indicating lights and switches in hinged drop-panel for access to wiring.
- H. The boiler system control panel shall include contacts for a manual CSD-1 emergency shutdown switch. The switch shall be furnished, installed, and wired by the Electrical Contractor. Switch shall be located at each exit just outside the boiler room door or as shown on plans. If boiler room door is on exterior of building, the switch shall be located just inside the door or as shown on plans. Verify final location with Architect/Engineer. The switch shall disable all boilers and shall be wired to the boiler burner safety control circuit to interrupt burner operation. If electrical plans and specifications do not show switch and wiring, the Mechanical Contractor shall furnish, install, and wire.
- I. Mechanical Contractor shall provide shutdown switch and associated wiring. The boiler shutdown switch shall be an emergency stop, mushroom head with N.C. contact, turn to release switch with engraved nameplate to read "BOILER EMERGENCY SHUTOFF". Square D XAL K174 or as approved by Architect/Engineer.

2.7 PERFORMANCE

- A. Minimum efficiency, verified by factory tests, shall be 91% at 100% output with 110°F return water and 96% at 25% output with 90°F return water.
- B. Rated for return temperatures as low as 40°F and supply temperatures as high as 190°F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements:

1. Install in accordance with manufacturer's instructions.
2. Provide for connection to electrical service.
3. Provide connection of gas service in accordance with ANSI/AGA Z223.1.
4. Pipe safety relief valve and condensate trap to nearest floor drain. Route condensate pipe to acid resistant floor drain.
5. Install circulation pump as recommended by the manufacturer.

B. Combustion Inlet and Venting:

1. Provide complete sealed combustion inlet and venting system.
2. Slope all horizontal runs of exhaust vent towards the boilers at a slope of 1" per 4'.

C. Service Clearance:

1. Install the boilers with a minimum of three feet clear space behind them for installation of piping and services. Verify exact maintenance clearances required by the manufacturer prior to installation.

3.2 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under factory authorized supervision.

B. Provide field representative for starting unit and training operator.

C. Provide combustion test and submit report. Test shall include boiler firing rate, overfire draft, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O₂), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent combustion efficiency, and heat output.

END OF SECTION 23 52 16

SECTION 23 62 13 - AIR COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Condensing Unit Package.
- B. Charge of Refrigerant and Oil.
- C. Controls and Control Connections.
- D. Refrigerant Circuit.
- E. Motor Starters.
- F. Electrical Power Connections.

1.2 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00 indicating components, assembly, dimensions, weights and loadings, required clearances, location and size of field connections, rated capacities, and electrical nameplate data. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system. Wiring and piping diagrams shall apply specifically to this job. Include description of capacity control logic and interface with building control system.
- B. Submit operation and maintenance data including start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units on site from physical damage. Protect coils.

1.4 WARRANTY

- A. Provide a one year parts and labor warranty. Compressors shall have an additional four year warranty covering all material and labor costs for compressor repair or replacement at the Owner's option.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.
- B. Construction and Ratings: In accordance with AHRI 210/240 and ANSI/UL 207 and 303. Testing shall be in accordance with ASHRAE 14.
- C. Performance Ratings: EER and COP meeting ANSI/ASHRAE 90.1.

2.2 CASING

- A. House components in welded steel frame with galvanized steel panels with painted finish meeting ASTM B117 salt spray test standard.
- B. Mount starters, disconnects, and controls in weatherproof panel with full opening access doors.
- C. Provide gasketed removable access doors or panels with quick fasteners.

2.3 CONDENSER COILS

- A. Aluminum fins mechanically bonded to seamless copper tubing. Provide 12°F of refrigerant subcooling at design conditions.
- B. Coil Guard: Painted expanded metal or PVC coated steel wire.
- C. Provide hail guards on all condenser coils.

2.4 CONDENSER FANS AND MOTORS

- A. Vertical discharge direct drive propeller type condenser fans with fan guards.
- B. Weatherproof motors suitable for outdoor use, single phase EC motor or 3 phase, with permanent lubricated ball bearings and built in thermal overload protection.
- C. Dynamically and statically balanced fans.
- D. Separate motors for each fan.
- E. Motors shall be variable speed for head pressure control.

2.5 COMPRESSORS

- A. Construction: Semi-hermetic or hermetic digital scroll type with suction and discharge valves.
- B. Mounting: Dynamically balance rotating parts and mount on vibration isolators.
- C. Lubrication System: Oil pump with oil charging valve, oil level sight glass, oil filter, and magnetic plug or strainer.
- D. Capacity Reduction Equipment: Multiple compressors with at least one compressor having digital scrolls or variable-speed compressors. Raywall valves are not acceptable.
- E. Motor: Suction gas cooled with electronic sensor and winding over temperature protection.
- F. Crankcase Heater: Evaporates refrigerant in crankcase during shutdown.
- G. Suitable for operating on voltages plus or minus 15% of nameplate ratings.

2.6 REFRIGERANT CIRCUIT

- A. Refrigerant may be new or reclaimed, and shall meet ARI-700-2004 Standard for Refrigerant Purity.
- B. Provide each unit with the number of refrigerant circuits needed to provide the scheduled unloading and properly transport oil.
- C. Provide the following for each refrigerant circuit:
 - 1. Replaceable core type filter dryer.
 - 2. Liquid line sight glass and moisture indicator.
 - 3. Thermal expansion valve.
 - 4. Insulated suction line.
 - 5. Suction and liquid line service valves.
 - 6. Schraeder valve.
 - 7. Condenser pressure relief valve.
 - 8. Suction filter.
 - 9. Liquid line solenoid valve.

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- D. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.
 - E. Refrigerant type and quantities shall meet the ozone depletion and global climate change limits of LEED credit EAc4, Enhanced Refrigerant Management (follow the latest edition at the time of bidding or as referenced in these specifications).

2.7 CONTROLS

- A. On unit, mount NEMA 4 steel control panel containing power and control wiring, factory wired with single point power connection.
- B. For each compressor, provide across-the-line starter, factory wired non-fused disconnects, non-recycling compressor overload, starter relay, and control power transformer. For each condenser fan, provide across-the-line starter with starter relay.
- C. Provide the following safety controls arranged so operating any one will stop unit:
 - 1. Manual reset high discharge pressure switch for each compressor.
 - 2. Automatic reset low suction pressure switch for each compressor.
 - 3. Manual reset oil pressure switch.
- D. Provide the following operating controls:
 - 1. Timer(s) that prevents compressor short cycling.
 - 2. Low ambient temperature (as scheduled) thermostat to lock out compressor.
 - 3. If discharge or return air control is provided with the unit, provide adjustable time delay between stages of operation. All units shall be compatible with direct control of staging by DDC systems. Suction pressure control of staging is not acceptable.
 - 4. Pump down control that activates when the lead compressor of each circuit stops.
 - 5. Thermostat to cycle fan motors in response to head pressure.
 - 6. Head pressure controlled variable speed fan control on first stage condenser fan. Rated for starting at 40°F.

2.8 ACCEPTABLE MANUFACTURERS

- A. Aeon.
- B. Carrier.
- C. Trane.
- D. York.
- E. Daikin/McQuay.
- F. Units shall be of the same manufacturer as the evaporator coil.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comb all condenser coils to repair bent fins.
- C. Install on vibration isolators as scheduled on the drawings or in Section 23 05 48.
- D. Connect to refrigeration piping and evaporators.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Provide initial start-up by factory authorized service representatives. Adjust units to provide proper superheat.
- B. Supply initial charge of refrigerant and oil for each refrigerant circuit. Replace losses of refrigerant and oil during the warranty period.

END OF SECTION 23 62 13

SECTION 23 72 00 - ENERGY RECOVERY DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

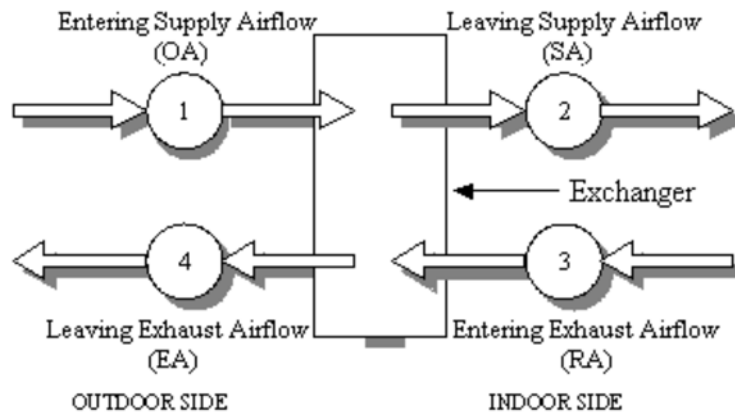
- A. Energy Recovery Wheels.

1.2 QUALITY ASSURANCE

- A. Sound Ratings: Tested to AMCA 300.
- B. Fabrication: Conform to AMCA 99 and AHRI 430.
- C. Enthalpy/Heat Recovery Wheels and Fixed Plate Energy Exchange Element: Effectiveness values shall be tested in accordance with ASHRAE 84, be AHRI certified to Standard 1060, and bear the AHRI Certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification program based on AHRI 1060.
- D. Unit shall bear a UL or ETL label of approval.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00.
- B. Energy transfer performance shall be clearly documented through a certification program conducted in accordance with ASHRAE 84 and AHRI 1060 standards. Submit enthalpy heat wheel AHRI 1060 compliance certification with reference number.
- C. Indicate ratings, heat wheel performance, pressure drop, outdoor air correction factor (OACF), exhaust air transfer rate (EATR), motor electrical characteristics, gauges, material finishes, assembly, unit dimensions, weight, required clearances, construction details, and field connection details.



- D. Submit manufacturer's installation instructions.
- E. Any exceptions to the specifications must be clearly noted. Contractor is responsible for any additional expenses that may occur due to any exception made.
- F. Submit operation and maintenance data. Include instructions for lubrication, belt replacement, motor and drive replacement, and spare parts lists.

G. Submit static pressure calculations showing total pressure drops.

1.4 EXTRA STOCK

A. Provide one extra set of energy recovery wheel drive belts. Deliver to Owner at job site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.6 WARRANTY

A. Provide manufacturer's 24-month parts and labor warranty on the heat wheel against defects in material and workmanship.

B. Provide manufacturer's 24 month parts and labor warranty on heat wheel drive belt and bearings against defects in material and workmanship.

1.7 MAINTENANCE SERVICE

A. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of belt replacement, and controls checkout, adjustments and recalibrations.

B. Submit copy of service call work order or report, and include description of work performed.

PART 2 - PRODUCTS

2.1 ENERGY RECOVERY WHEEL

A. Heat Wheel:

1. Wheel shall provide both sensible and latent heat recovery. Sensible and latent effectiveness shall meet or exceed scheduled values.
2. The media shall be fluted, corrugated in design to minimize the leakage of the exhaust air to the supply air through the media. The rotor media shall be coated with a polymer to avoid oxidation and latent energy transfer. Silica gel and oxidized aluminum are not acceptable. All media surfaces shall be coated with polymer prior to being formed into the fluted media structure. Surfaces sprayed, dip coated, or polymers that must be reapplied over time are not acceptable. Impregnated polymers in non-metallic substrates, such as paper, synthetic, plastic or glass fiber, will not be acceptable. Wheels with polymer applied after wheel formation are not acceptable. Wheels shall be treated for corrosion resistance to water moisture.
3. Energy recovery effectiveness values shall be tested in accordance with ASHRAE 84 and be AHRI certified to Standard 1060 and bear the AHRI Certification symbol for AHRI Air-to-Air Energy Recovery Ventilation Equipment Certification program based on AHRI 1060.
4. Seal: Heat wheel cassette shall be complete with face seal and perimeter seal to prevent cross leakage between the two airstreams. Both seals shall be non-wearable to minimize leakage up to specified differential pressure. Seals shall be adjustable.

-
5. Casing: Rotor casing shall limit the deflection of the rotor due to air pressure differential to less than 1/32 inch at design differential pressure. Framing shall be galvanized steel, aluminum, or other metal treated to be corrosion resistant to water moisture. Any exposed metal that is not corrosion resistant to water moisture shall be painted with primer and corrosion-resistant paint. Support rotor from bearings selected to support the rotating weight of the wheel. The bearings shall be maintained or replaced without removal of the rotor from its casing or the media from its spoke system.
 6. Frame: The rotor frame shall be an industrial spoke system that provides the structural integrity required at design pressure differentials. Wheel construction shall allow for post-fabrication wheel alignment.
 7. Drive: Rotor shall be driven from belt system and electric motor. Wheel shall be perimeter driven with pulley sized properly for wheel size and rotation speed. Rotor belt shall have no field adjustments required (0% stretch after initial tension). Provide motor with internal overload protection.
 8. Frost Control: Provide variable speed control on rotors for frost control. Provide VFD inverter with manual override speed adjustment and turn down ratio of 20:1. Bypass dampers shall be controlled to bypass outdoor air around the wheel to avoid frosting conditions on the wheel.
- B. Media Cleaning:
1. The media shall be cleanable with hot water or light detergent, or compressed air (less than 80 psi) without degrading the latent recovery. Dry particles up to 800 microns shall freely pass through the media. Heat wheel shall be self-cleaning by two counter flow airstreams.
- C. Purge Section:
1. Unit to be provided with a factory set, field adjustable purge section designed to limit cross contamination to less than 0.04 percent of the exhaust flow rate. Purge swing arm shall be fully sealed with seals as described above. Rotation of wheel shall be in the direction from the return air through the purge to the supply air side.
- D. Controls:
1. Unit shall be provided with a variable speed drive to control the rate of wheel rotation for temperature and frost control. Provide VFD inverter with manual override speed adjustment. The variable speed drive shall be designed for heat wheel applications and include: start/stop input from a dry contact and a 0-10VDC speed control input. Wheel shall be provided with rotation detection dry contacts for connection to direct digital controller. Refer to control drawings for additional information.
- E. Acceptable Manufacturers: Semco, Innergy Tech, Novel Aire, DRI, Seibu Giken (SG America), Enventus or Xetex/AIRotor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install per manufacturer's instructions.

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- B. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan(s) have been test run under observation.
 - C. P-traps must be installed for all drain pans.

END OF SECTION 23 72 00

SECTION 23 73 13 - INDOOR MODULAR AIR HANDLING UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Modular Indoor Air Handling Units.

1.2 QUALITY ASSURANCE

- A. AHU Unit: Manufacturer specializing in design and manufacturing of the products specified in this section with a minimum of five years' experience.
- B. Fabrication: Conform to AMCA 99 and AHRI 430.
- C. Fan Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- D. Sound Ratings: Tested to AMCA 300.
- E. Air Coils: Certify capacities, pressure drops, and selection procedures per AHRI 410.
- F. Electrical control wiring shall be in accordance with NEC codes and ETL requirements.
- G. Unit shall contain only UL listed components.
- H. Conform to ASHRAE 90.1.
- I. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Indicate ratings, fan performance, motor electrical characteristics, gauges, material finishes, assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
 - 1. Product Data
 - a. Provide fan curves with specified operating point clearly plotted. Select fans using external static pressure noted in the schedule. Manufacturer responsible for calculation of internal static pressure. Manufacturer shall include an allowance for clean filters in the internal static pressure. An allowance for the difference between dirty filters and clean filters is included in the external static. Submit static pressure calculations showing total pressure drops, including tabulated internal pressure drops and specified external static pressure drops
 - b. Submit sound power level data for both fan outlet and casing radiation at rated capacity.
 - c. Submit shop drawings indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions
 - d. Submit manufacturer's data showing that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.

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- e. Provide a copy of data of filter media, filter performance data, filter assembly, and filter frames with unit submittal for reference only.
 - B. Submit manufacturer's installation instructions.
 - C. All base bid pricing shall be based on the drawings, schedules and this specification
 - 1. If a manufacturer requests to deviate from the requirements described herein, the Manufacturer and/or Contractor may list voluntary add or deduct prices on the bid form. These voluntary prices will not be used in determining the low bidder.
 - 2. All voluntary adds or deducts shall be discussed and agreed to by the Owner and Architect/Engineer prior to the award of the air handling unit bid and before the submittal process begins.
 - D. Any exceptions to the specifications must be clearly noted to the Architect/Engineer prior to acceptance. Contractor is responsible for all expenses due to exceptions.
 - E. Submit operation and maintenance data. Include instructions for lubrication, filter replacement, motor and drive replacement, and spare parts lists.
- 1.4 EXTRA STOCK
- A. Provide clean filters in all units at time of installation.
 - B. Provide clean filters in all units at project final completion after all interior finishes are complete.
 - C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Deliver products to site with protective coverings in-place. Loose shipped items must be in factory-provided protective coverings, with factory-installed shipping skids and lifting lugs.
 - B. Store unit in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.
- 1.6 WARRANTY
- A. Provide a manufacturer's 1-year parts and labor warranty against defects in material and workmanship.
- 1.7 GENERAL DESCRIPTION
- A. Unit Location:
 - 1. The air handling unit (AHU-#) is a variable air volume modular unit, located in a conditioned mechanical room in the basement.
 - 2. The unit will be set on a concrete housekeeping pad by the Contractor.
 - B. Unit Description:
 - 1. The unit shall contain all the components described in these specifications and shown on the drawings and schedules.
 - 2. Refer to air handling unit drawings and schedules for additional information

PART 2 - PRODUCTS

2.1 MODULAR INDOOR AIR HANDLING UNITS

A. Acceptable Manufacturers

1. Carrier – 39 Series.
2. Trane – “M” Series.
3. Daikin/McQuay – Vision.
4. York – Solutions.
5. Ventrol – ITF Indoor Unit.

B. Housing:

1. Minimum 18 gauge G60 galvanized steel exterior panels reinforced and braced with galvanized steel framework.
2. Removable access panels for coil and fan removal.
3. Unit shall be double wall insulated constructed panel. Exterior wall shall be minimum 18 gauge galvanized steel. Interior wall shall be minimum 20 gauge perforated plate galvanized steel. Foil facing on insulation shall not be acceptable as a substitute for double wall construction. If casing sections are not provided by the unit manufacturer with double wall construction, the Contractor is responsible for covering exposed insulation with galvanized sheet metal. The minimum R-value of the panel assemblies shall be 8.
4. Install a stainless steel drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height downstream from the downstream face. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8” per foot.
5. Units shall be draw-thru or blow-thru as noted on the drawings and shall not exceed the overall dimensions.

C. Doors:

1. Unit doors shall be double wall and insulated with the same materials used in the surrounding unit walls.
2. Doors shall contain a continuous neoprene bulb type gasket.
3. Each door shall contain a double pane tempered, reinforced or safety glass window.
4. Each door shall have a minimum of two (2) high compression type latches, operable from both sides.
5. Unit shall have full height, galvanized, double wall, and hinged, removable access doors on both sides of fan.

D. Access Sections:

1. Provide access sections as shown on the drawings between unit sections.

E. Fan:

1. Double width, double inlet, airfoil centrifugal.

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2. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type. Substitution of BI or BIA fans for FC is acceptable if efficiency is not lower.
 3. Statically and dynamically balanced.
 4. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating conditions.
 5. Provide extended lubrication lines for all bearings to an easily accessible location.
 6. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the design speed.
 7. Fan(s) shall have internal spring isolators.
 8. Fans shall be direct drive style.

F. Motors and Drives:

1. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.
2. Motors shall be open drip-proof or TEFC type with grease lubricated bearings.
3. Motors shall be "variable frequency drive rated". Refer to Section 23 05 13.
4. Motors shall be rated and warranted to 90 Hz operation.

G. Coils:

1. Direct Expansion Coils:
 - a. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.
 - b. Galvanized steel casing.
 - c. Suitable for 250 psig. Maximum air velocity shall not exceed scheduled rate.
 - d. AHRI rated for direct expansion use with R-410A.
 - e. Size coils based on saturated suction temperature, EAT and cfm scheduled. The leaving DB and APD shall not exceed the scheduled values.
 - f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no anti-carryover coating shall be used.
 - g. All coils shall be intertwined configuration.
 - h. Minimum 0.016" tube wall thickness.
 - i. Acceptable Manufacturers: Trane, York, Heatcraft, or Daikin/McQuay.

H. Mixing and Filter Section

1. Provide with a mixing box section. Damper arrangement shall be as shown on the drawings. Furnish dampers with the unit. Dampers shall be extruded aluminum with 6" airfoil blades, compressible metal jamb seals, molded synthetic or stainless steel sleeve bearings. The damper shall not leak more than 4 cfm/sq.ft. at 1" W.C. as tested per AMCA Standard 500-D-98. Maximum

damper size shall be 48" in length. Provide multiple damper sections for larger lengths. Multiple dampers shall use individual actuators. Jackshafting is not acceptable. Filters shall be as scheduled and have full size hinged access doors.

2. Provide filter section for 4" thick filters. Maximum filter velocity shall not exceed specified value. Provide full size hinged access doors.
 3. Reference Section 23 40 00 for filter requirements.
- I. Energy Recovery Devices
1. Reference Section 23 72 00 for energy recovery device requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements

1. Install per manufacturer's instructions.
2. During construction provide temporary closures of metal or taped polyethylene over openings into housing ducts to prevent dust from entering ductwork.
3. Seal all contractor installed penetrations airtight. Seal all openings prior to cleaning. Seal holes with proper SMACNA closures conforming to pressure class of the housing.
4. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Coil Requirements:

1. Comb all coils to repair bent fins.
2. Extend coil drain and vent connections to outside unit housing. Provide normally closed valve on drain and vent connection outside of unit housing.

END OF SECTION 23 73 13

SECTION 23 74 23.13 - GAS FIRED MAKE-UP AIR UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Direct Fired Make-Up Air Unit.
- B. Indirect Fired Make-Up Air Unit.

1.2 QUALITY ASSURANCE

- A. Comply with applicable regulations and have local Gas Company approval.
- B. Factory test to check construction, controls, and operation of unit and provide certification.
- C. Test operation after installation.
- D. Provide with complete one (1) year warranty. Warranty period begins at date of initial startup.
- E. Conform to ASHRAE 90.1.
- F. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00 showing dimensions, connections, arrangement, accessories, electrical service and duct connections, and controls.
- B. Submit manufacturer's installation instructions.
- C. Submit operation and maintenance data including manufacturer's descriptive literature, maintenance and repair data, and parts listing.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from physical damage by storing off-site until ready for installation.

PART 2 - PRODUCTS

2.1 DIRECT FIRED MAKE-UP AIR UNIT

- A. Acceptable Manufacturers:
 - 1. Greenheck.
 - 2. Modine
- B. Manufactured Units:
 - 1. Self-contained direct-fired make-up air unit with burner, inlet damper, gas controls, unit controls, and all accessories noted or required for complete installation.
 - 2. Units shall bear a UL, ETL or AGA label indicating that the units have been tested and comply with Standard ANSI Z83.4.

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3. Suspended mounted inside building.
 4. Unit to consist of direct-fired gas burner, unit cabinet and frame, direct drive supply fan, and all unit and burner safety and control devices.
 5. Controls shall include terminal connections for setpoint adjustment and system enable/disable.
 6. Furnish non-fused disconnect switch, short circuit protection of all internal electrical components, and all necessary motor starters, contactors, and over-current protection.
- C. Fabrication:
1. Construct heater casing and components of 18 gauge steel panels, reinforced with angles and channels for rigidity. Provide access panels to burner and blower motor assemblies.
 2. Locate port on burner section for observing main and pilot flames.
 3. Insulate indoor units up to burner section with 1" thick neoprene faced glass fiber insulation.
 4. Finish casing and components with heat resistant baked enamel.
- D. Filters:
1. Provide filter section complete with removable 4" thick MERV 8 pleated filter. Refer to 23 40 00 for requirements.
- E. Burner:
1. Provide natural gas burner with modulating turndown ratio of 25:1. Adjustable profile plate, stainless steel baffles, cast iron burner tube.
 2. Gas Burner: Forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shutoff, intermittent spark, flame sensing device, and automatic 100 percent shutoff pilot.
 3. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.
 4. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de-energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
- F. Fan:
1. Provide statically and dynamically balanced direct drive centrifugal fan.
- G. Unit Controls:
1. Pre-wire unit so connection of power supply and field wiring to unit's terminal strip makes unit operative. Wiring and control enclosures shall meet NEC and local codes. Provide pre-wired, numbered terminal strips for field wiring connections to Building Automation System.
 2. Provide the following safety controls: air flow switch, electronic flame safety relay, high temperature limit switch, starter interlock, high gas pressure switch, low gas pressure switch, low discharge temperature control with bypass timer.

H. Gas Manifold:

1. Pilot line shall include: gas shutoff valve, gas regulator, pilot gas valve.
2. Main gas line shall include: gas shutoff valve, gas regulator, main gas valve (2 required), modulating gas valve, leakage test valve, low pressure gas switch, high pressure gas switch, vent valve between the two main gas valves and all required test valves.
3. Gas train shall meet FIA/IRI, local utility, and Owner's insurance company requirements.
4. Provide piping from vent valve to outside the building.
5. Provide additional regulator if the incoming gas pressure exceeds 2 psig.
6. Locate all valves and components in a unit mounted enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that area is ready to receive work and opening dimensions are as indicated on the shop drawings and illustrated by the manufacturer.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All field wiring shall be per the National Electrical Code.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Provide initial start-up and shutdown during first year of operation, including routine servicing and check-out.

END OF SECTION 23 74 23.13

SECTION 23 82 00 - TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Finned Tube Radiation.
- B. Panel Radiation.
- C. Convector.
- D. Unit Heaters.
- E. Duct Free Split Systems

1.2 QUALITY ASSURANCE

- A. All filters shall be UL listed Class 1 or Class 2.
- B. All electrical equipment shall have a UL label.
- C. All gas fired units shall be AGA approved or UL listed.
- D. All gas trains shall comply with utility company and code requirements.
- E. All louvers and dampers shall have AMCA certified ratings.
- F. Factory wired equipment shall conform to ANSI/NFPA 70.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00.
- B. Submit catalog data including arrangements, cross sections of cabinets, grilles, bracing, typical elevations.
- C. Submit schedules of equipment and enclosures indicating length, number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, and comparison of specified to actual heat output.
- D. Indicate mechanical and electrical service locations and requirements. Show deviations from scheduled products.
- E. Submit manufacturers' installation instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect units from physical damage by storing in protected areas and leaving factory covers in place.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ASHRAE 90.1.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's operation and maintenance data. Include operating, installation, maintenance and repair data, and parts listings.

PART 2 - PRODUCTS

2.1 FINNED TUBE RADIATION - WALL HUNG

- A. Cabinets shall be 14 gauge steel with baked enamel finish.
- B. Final color selection shall be by the Architect.
- C. Element hangers shall be quiet operating, cradle type.
- D. Cabinet top shall be continuously supported on wall mounting strips. Lower front face of cabinet shall be secured to the enclosure brackets.
- E. All cabinet and accessories shall be securely connected with no exposed fasteners.
- F. Provide end caps, corner pieces, adjustable extensions, etc. as required for proper appearance and service.
- G. Provide custom cabinet at corners where, in the Architect/Engineer's opinion, standard fittings will not fit correctly or have acceptable appearance. Custom cabinet shall be 14 gauge sheet metal with finish and shape to match manufacturer's cabinet. Submit drawings of each custom cabinet for approval.
- H. Provide removable cabinet sections at all control valves. It shall not be necessary to remove several sections to maintain control valves.
- I. Support 1/2" tubes on 36" centers and larger tubes on 48" centers.
- J. Elements shall be copper tube with aluminum fins.
- K. Cabinet size, element length, and element size shall meet the scheduled capacities, but not be less than the sizes scheduled.
- L. Acceptable Products: Vulcan 'Linovector', Sterling 'Versa-Line', Rittling 'Regency', Shaw-Perkins 'Crown-Line'.

2.2 PANEL RADIATION

- A. All components shall be steel.
- B. With corrugated fins welded to flat horizontal tubes to connect to vertical headers at each end.
- C. Headers with inlet, outlet, vent and drain connections, and baffles for even heat distribution.
- D. Provide integral all-welded perforated top grille.
- E. Rated for 56 psi working and 74 psi test pressure.
- F. Rated per ISO 1503147-3150.
- G. Units to have gloss powder-coated finish. Color selection by the Architect. Furnish color charts with shop drawings.
- H. Install mounting hardware per manufacturer's recommendations. Conceal all mounting hardware.
- I. Acceptable Manufacturer: Runtal, Rittling, Vulcan, Sterling.

2.3 CONVECTORS

- A. Heating Elements: Seamless copper tubing mechanically expanded into evenly spaced aluminum fins, steel side plates and supports, factory air pressure tested at 100 psi under water.

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- B. Cabinet: 16 gauge steel front and top; 18 gauge steel back and ends; exposed corners rounded; easily secured removable front panels, adequately braced and reinforced for stiffness. Cabinets within holding cells shall be 16 gauge stainless steel front with tamper resistant fasteners.
 - C. Finish: Factory applied baked enamel on exposed surfaces. Color selection by Architect.
 - D. At otherwise inaccessible valves, provide 6" x 7" minimum size factory-made hinged access doors integral with cabinet.
 - E. Acceptable Manufacturers: Sterling, Vulcan, Rittling, Modine, Shaw-Perkins, Sigma.

2.4 UNIT HEATERS

- A. Casings shall be heavy gauge steel with a baked finish.
- B. Coils shall have copper heads and tubes, and aluminum fins.
- C. Units shall have threaded pipe connections for hanger rods.
- D. Fans shall be direct drive propeller type, factory balanced, with fan guards and totally enclosed motors with integral thermal overload protection.
- E. Horizontal units shall have adjustable outlet air louvers.
- F. Provide unit mounted and wired disconnects. Contractor shall be responsible for providing and wiring disconnect when using a manufacturer who does not provide factory mounted option.
- G. Acceptable Products: Trane - S or P, Daikin/McQuay - UHH or UDH, Modine - HS or V, Vulcan - HV or VV, Sterling HS or VS, Rittling - H or V, Sigma H or V, Airtherm HA or VA.

2.5 DUCT FREE SPLIT SYSTEM

- A. Split system air-cooled terminal with wall mounted fan coil, electric refrigeration system, integral temperature controls, and remote mounted heat pump unit or condensing unit as scheduled.
- B. Warranty: Provide one-year manufacturer's warranty on parts and defects and six years on the compressor.
- C. Cabinet: Wall mounted thermal plastic with integral finish. Fully insulated
- D. Discharge Grille: Fan shall be tangential direct--drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor--driven vertical air sweep shall be provided standard.
- E. Indoor unit shall include:
 - 1. Direction expansion cooling coil.
 - 2. Expansion valve and reversing valve.
 - 3. Centrifugal forward curved evaporator fans with multi-speed split capacitor motors.
 - 4. Integral controls for temperature set point adjustment.
 - 5. Plastic drain pan formed to prevent ponding or water retention.
 - 6. Washable air filters.
- F. Outdoor unit shall include:

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1. Inverter type hermetically sealed rotary compressor with internal spring isolation, external isolation, permanent seal capacitor motor and overload protection.
 2. Condenser coil.
 3. Propeller type condenser fan with split capacitor motor.
 4. R-410a charged and insulated refrigerant line set sized for location shown.
- G. Performance shall be based on ARI 210 or ARI 240 test conditions.
- H. Coordinate installation of units with architectural and electrical work.
- I. Supply units fully charged with refrigerant and filled with oil.
- J. Unit shall include PAR31MAA thermostat with BACnet device for integration to Building Automation System.
- K. Approved Manufacturers: Mitsubishi or pre-approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install all products per manufacturers' instructions.
2. Coordinate recess sizes for recessed equipment.
3. Protect units with protective covers during construction.
4. Comb all coils to repair bent fins.

B. Fin Tube:

1. Locate finned tube radiation as shown and run cover wall-to-wall, unless otherwise shown. Center elements under windows.

C. Unit Heater:

1. Hang unit heaters from building structure, not from piping. Mount as high as possible within manufacturer's recommended mounting height requirements. If unit heaters cannot be installed within manufacturer's recommended range, notify Architect/Engineer prior to mounting.

3.2 CLEANING

- A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by manufacturer.
- C. Install new filters.

END OF SECTION 23 82 00

SECTION 23 82 16 - AIR COILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Coils.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 23 05 00.
- B. Submit shop drawings indicating coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- C. Submit manufacturer's installation instructions.
- D. Submit manufacturer's data showing that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- B. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 - PRODUCTS

2.1 HOT WATER COILS

- A. Extended surface type with seamless copper tubes and continuous plate type aluminum fins.
- B. Suitable for continuous operation at 200 psi. Maximum air velocity of 1,000 fpm.
- C. Galvanized steel casing.
- D. AHRI rated with 0.0005 fouling factor.
- E. Coils shall be sized based on EWT, EAT, gpm and cfm as scheduled. LAT shall be at least as high as scheduled. APD and WPD shall not exceed scheduled values.
- F. Maximum 144 fins per foot.
- G. Turbulators are not permitted unless tube velocities are below 2 FPS at design flow or noted otherwise. Turbulators shall not be allowed if removable headers are specified.
- H. Coils shall have vent connections, with valves, at the supply and return headers.
- I. Install coils level to allow drainage.
- J. Coils scheduled for over 2,000 cfm shall have valved drain connections at both headers.
- K. Headers and pipe connectors shall be copper or brass for use in copper piping systems or cast iron with ferrous pipe connectors for use in steel piping systems. If header material does not match the piping material, use dielectric fittings at the change in material.

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- L. All duct coils shall have slip and drive connections with clearance sufficient for removal of coils from ducts.
 - M. Minimum 0.024" tube wall thickness.
 - N. Acceptable Manufacturers: Trane, York, Daikin/McQuay, Heatcraft, Commercial Coil, American Air Filter.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install coils in accordance with manufacturer's instructions. Pipe coils with air flow and water flow in opposite directions (counter flow).
 - 2. Protect coils to prevent damage to fins and flanges.
 - 3. Make connections to coils with offsets and unions or flanges to allow coil to be removed without disturbing valves.
 - 4. Comb all coils to repair bent fins.
- B. Duct Mounted Coil:
 - 1. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
 - 2. Insulate U-bends located outside ducts or casings as specified for ductwork.

END OF SECTION 23 82 16

SECTION 26 05 00 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements. This section is also applicable to Interior Communications Pathways Section 27 05 28. This section is also applicable to Fire Alarm and Detection Systems Section 28 31 00.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced in each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make his portion of the Electrical Work a finished and working system.
- C. Description of Systems shall be as follows:
 - 1. Electrical power system to and including light fixtures, equipment, motors, devices, etc.
 - 2. Electrical power service system from the Utility Company to and including service entrance equipment, distribution and metering.
 - 3. Grounding system.
 - 4. Fire alarm system.
 - 5. Public address and intercom system.
 - 6. Clock and program system.
 - 7. Security system.
 - 8. Wiring system for temperature control system as shown on the drawings.
 - 9. Lightning protection system.
 - 10. Wiring of equipment furnished by others.
 - 11. Removal work and/or relocation and reuse of existing systems and equipment.
 - 12. Technology Systems as described in Division 27/28 and on the T-series documents as described in the Suggested Matrix of Scope Responsibility.
- D. Work Not Included:
 - 1. Telecommunications cabling will be by others, in raceways and conduits furnished and installed as part of the Electrical work.
 - 2. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.3 OWNER FURNISHED PRODUCTS

- A. The Owner will supply manufacturer's installation data for new equipment purchased by him for this project.
- B. This Contractor shall make all electrical system connections shown on the drawings or required for fully functional units.
- C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.4 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, AND CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
 - 1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
 - 2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in Division 27/28 of this Specification.
 - 3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
 - 4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
 - 5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
 - 6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
 - 7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
 - 8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
 - 9. Low Voltage Technology Wiring: The wiring associated with the Technology Systems, used for analog or digital signals between equipment.
 - 10. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications information outlets.

C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical bus duct.
 - d. Sheet metal.
 - e. Cable trays, including access space.
 - f. Other piping.
 - g. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.
2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.
3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".
2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.
3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.
4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Technology Wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).

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4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Technology equipment which is required to be bonded to the telecommunications ground bar.
 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.

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3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.

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7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
 8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.
2. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do not comply with the codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, he shall submit with his proposal a separate price to make the system comply with the codes and regulations.
4. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
5. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
6. If there are no local codes having jurisdiction, the current issue of the National Electrical Code shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.
7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.
8. Pay all telephone company charges related to the service or change in service.

E. Utility Company Requirements:

1. Secure from the private or public utility company all applicable requirements.
2. Comply with all utility company requirements.
3. The Owner shall make application for and pay for new electrical service equipment and installation. The Contractor shall coordinate schedule and requirements with the Owner and Utility Company.
4. Furnish the meter socket. Verify approved manufacturers and equipment with the Utility Company.
5. The Owner shall apply and pay for any changes for removal of existing electrical service by the utility company. The Contractor shall verify approved manufacturers and equipment with the Utility Company.

F. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways so as to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
6. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.
7. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better quality number shall govern.
8. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install" shall mean connect up complete and ready for operation, and the word "provide" shall mean to supply for use and connect up complete and ready for operation.
9. Any item listed as furnished shall also be installed unless otherwise noted.
10. Any item listed as installed shall also be furnished unless otherwise noted.

G. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways, bus duct, fittings, etc.

1.7 SUBMITTALS

A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
26 05 13	Wire and Cable
26 05 17	Electric Heat Trace and Snow Melt
26 05 26	Grounding and Bonding
26 05 35	Surface Raceways
26 05 73	Power System Study
26 09 33	Lighting Control System
26 20 00	Service Entrance
26 22 00	Dry Type Transformers
26 24 16	Panelboards
26 24 19	Motor Control
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16	Disconnect Switches
26 28 21	Contactors
26 31 00	Solar Photovoltaic Systems
26 32 13	Packaged Engine Generator Systems
26 36 00	Transfer Switch
26 43 00	Surge Protection Devices
26 51 00	Lighting
26 52 15	Emergency Power Supply
28 31 00	Fire Alarm and Detection Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses

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- f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

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- e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
 7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
- C. Electronic Submittal Procedures:
1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
 4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 26 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 26 XX XX.description.YYYYMMDD

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5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

1.8 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 1.
- B. Format:
 1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:
 1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
 2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
- D. Update Schedule of Values when:
 1. Indicated by Architect/Engineer.
 2. Change of subcontractor or supplier occurs.
 3. Change of product or equipment occurs.

1.9 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.
- B. Change order work shall not proceed until authorized.

1.10 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Keep all materials clean, dry and free from damaging environments.
- C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate his/her work with other trades.

1.11 WARRANTY

- A. Refer to Division 1 specification for requirements.

1.12 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis of design and establishes the quality required.
- B. Refer to Division 1 for all other material substitution requirements.

1.14 LEED REQUIREMENTS

- A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New Construction V 3.0. The Contractor shall provide all services and documentation necessary to achieve this rating.

1.15 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) and provide all services necessary for compliance with US Green Building Council LEED Prerequisite EAc1, and EAc3 Enhanced Commissioning. See sections 01 91 00, 01 91 10, and 01 91 20.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
 2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with his work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.
9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.
10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.
12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. Confirm that all inspections are complete before filling or backfilling.

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2. No rubbish or waste material is permitted for fill or backfill.
 3. Furnish all necessary sand for backfilling.
 4. Dispose of the excess excavated earth as directed.
 5. Backfill materials shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.
 6. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.
 7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6" uniform horizontal layers with each layer compacted separately to required density.
 8. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.
 9. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.
 10. Backfill with sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.
 11. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.
 12. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
 13. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
1. Placing fill over underground and underslab utilities.
 2. Covering exterior walls, interior partitions and chases.

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3. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation:
1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical Identification.
 - b. Light fixtures, including ceiling-mounted exit and emergency lights, are installed and operational.
 - c. Light fixture whips are suspended above the ceiling.
 - d. Conduit identification is installed in accordance with Section 26 05 53 Electrical Identification.
 - e. Light fixtures are suspended independently of the ceiling system when required by these contract documents.
 - f. All wall penetrations have been sealed.
 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 PROJECT CLOSEOUT

- A. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
1. In order to prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the completion status of the project and certify that the job is ready for the final jobsite observation.
 2. Attached to the end of this section is a typical list of items that represent the degree of job completeness expected prior to requesting a review. The Contractor shall sign the attached certification and return it to the Architect/Engineer so that the final observation can be scheduled.
 3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and additional trips and observations are required to bring the project to completion, the cost of the additional time and expenses incurred by the Architect/Engineer will be deducted from the Contractor's final payment.
 4. Contractor shall notify Architect/Engineer 72 hours prior to installation of ceilings or lay-in ceiling tiles.

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- C. The following must be submitted before Architect/Engineer recommends final payment:
1. Operation and maintenance manuals with copies of approved shop drawings.
 2. Record documents including reproducible drawings and specifications.
 3. A report documenting the instructions given to the Owner's representatives complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of this Contractor and shall be signed by the Owner's representatives.
 4. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed and submit receipt to Architect/Engineer.
 5. Inspection and testing report by the fire alarm system manufacturer.
 6. Start-up reports on all equipment requiring a factory installation or start-up.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div23.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.

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8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.
- C. Paper Copy Submittal Procedures:
1. Once the electronic version of the manuals has been approved by the Architect/Engineer, _____ paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
 2. Binder Requirements: The Contractor shall submit three sets of O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2"12mm thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
 3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
 4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.
- D. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
 2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
 3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
 4. Copies of all factory inspections and/or equipment startup reports.
 5. Copies of warranties.
 6. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 7. Dimensional drawings of equipment.
 8. Detailed parts lists with lists of suppliers.
 9. Operating procedures for each system.
 10. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 11. Repair procedures for major components.

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12. Replacement parts and service material requirements for each system and the frequency of service required.
 13. Instruction books, cards, and manuals furnished with the equipment.
 14. Include record drawings of the one-line diagrams for each major system. The graphic for each piece of equipment shown on the one-line diagram shall be an active link to its associated Operation & Maintenance data.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The instructions shall include:
 1. Maintenance of equipment.
 2. Start-up procedures for all major equipment.
 3. Description of emergency system operation.
- E. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative so his representative can be present if desired.
- F. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- G. Operating Instructions:
 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.
 2. If the Contractor does not have staff that can adequately provide the required instructions, he shall include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 RECORD DOCUMENTS

- A. The following paragraphs supplement the requirements of Division 1.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.

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- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 PAINTING

- A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, he shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.
- C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.
- D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect his color preference before ordering.
- E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- F. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect.
- G. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.
- H. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.
- I. In accordance with LEED EQc4.2: Low-Emitting Materials - Paints and Coatings, all paints and coatings used on the interior of the building must comply with the following criteria:
 - 1. Architectural paints and coatings applied to interior walls and ceilings must not exceed the volatile organic compound (VOC) content limits established in Green Seal Standard GS-11, Paints, 1st Edition, May 20, 1993.
 - 2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the VOC content limit of 250 g/L (2 lb./gal) established in Green Seal Standard GC-03, Anti-Corrosive Paints, 2nd Edition, January 7, 1997.

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.
- D. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 - 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 - 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

3.11 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Within the limits of Construction:
 - 1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.
 - 2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.
- B. Outside the limits of Construction:
 - 1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.
 - 2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
 - 3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.

3.12 SYSTEM COMMISSIONING

- A. The electrical systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
 - 1. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the

Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.13 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction.
2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
4. Any wiring device, electrical apparatus or lighting fixture, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than the National Electrical Code Standards. Take readings between conductors, and between conductors and ground.
6. If the results obtained in the tests are not satisfactory make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)
2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain.
3. If the ground resistance value obtained is more than the value set forth in Section 26 05 26, the following shall be done to obtain the value given:
 - a. Verify that all connections in the service ground system are secure.
 - b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.
 - c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.
 - d. Review results with the Architect/Engineer.
4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:
 - a. Date of test.
 - b. Number of hours since the last rain.

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- c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.
 - d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.
 - e. Make, model, and calibration date of test equipment.
 - f. Tabulation of measurements taken and calculations made.
- C. Other Equipment:
- 1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.
- D. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

3.14 CONSTRUCTION WASTE MANAGEMENT

- A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRC2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).
- 1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.
 - 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor's scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.
 - a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.
 - b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.
 - 3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or salvaged.

3.15 UTILITY REBATE

- A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.
- B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

END OF SECTION 26 05 00

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 26 05 00, cable insulation test results have been submitted.
5. Per Section 26 05 00, ground resistance test results have been submitted.
6. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
7. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
8. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
9. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
10. Start-up reports from factory representative have been submitted as per Section 26 05 00.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

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SECTION 26 05 03 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for installation.

1.3 REFERENCES

- A. UL 723 - Surface Burning Characteristics of Building Materials
- B. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- C. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- D. Intertek / Warnock Hersey - Directory of Listed Products
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- F. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- G. Wisconsin Administrative Code

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- B. Install material prior to expiration of product shelf life.

1.5 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
 - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
 - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings:
 - a. Floor penetrations located outside wall cavities.
 - b. Floor penetrations located outside fire-resistance-rated shaft enclosures.

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3. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 5.0 cfm/sq.ft. (0.0254 cu. m/s x sq. m) at both ambient temperature and 400°F (204°C) for smoke barriers.
 - C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
 - D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
 - E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.
 - F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants used on the interior of the building must comply with the following requirements:
 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000.

1.6 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 1. Review foreseeable methods related to firestopping work.
 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.7 WARRANTY

- A. Provide one year warranty on parts and labor.
- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
 1. 3M; Fire Protection Products Division.
 2. Hilti, Inc.
 3. RectorSeal Corporation, Metacaulk.
 4. Tremco; Sealant/Weatherproofing Division.
 5. Johns-Manville.

- 6. Specified Technologies Inc. (S.T.I.)
- 7. Spec Seal Firestop Products
- 8. AD Firebarrier Protection Systems
- 9. Wiremold/legrand: FlameStopper

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.
- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- E. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- F. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size and material and shall fall within the range of numbers listed:

- 1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
 F Rating = Floor/Wall Rating
 T Rating = Floor/Wall Rating
 L Rating = Penetrations in Smoke Barriers

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999

- 2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
 F Rating = Wall Rating
 T Rating = 0
 L Rating = Penetrations in Smoke Barriers

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999

<u>Penetrating Item</u>	<u>UL System No.</u>
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999

3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
 F Rating = Wall/Floor Rating
 T Rating (Floors) = Floor Rating
 L Rating = Penetrations in Smoke Barriers

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999

*Alternate method of firestopping is patching opening to match original rated construction.

- G. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.
- H. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the contractor's expense.

END OF SECTION 26 05 03

SECTION 26 05 13 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire
- B. Remote control and signal cable
- C. Fire rated cable

1.2 REFERENCES

- A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- B. UL 44 – Thermoset-Insulated Wires and Cables
- C. UL 83 – Thermoplastic-Insulated Wires and Cables
- D. UL 854 – Service-Entrance Cables
- E. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600 volt insulation, THHN/THWN or XHHW-2.
- B. Feeders and Branch Circuits Larger than 6 AWG in Underground Conduit: Copper, stranded conductor, 600 volt insulation, XHHW-2.
- C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600 volt insulation, THHN/THWN. 6 and 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the drawings.
- D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600 volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings.
- E. Control Circuits: Copper, stranded conductor 600 volt insulation, THHN/THWN.
- F. Each 120 and 277 volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for wire derating. Shared Neutrals between different branch circuits or other wiring are not acceptable.

2.2 REMOTE CONTROL AND SIGNAL CABLE

- A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.
- B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.3 FIRE-RATED CABLE

- A. Two-hour Fire Rated Mineral Insulated Cables: Copper conductor, 600 volt insulation, rated 90°C, Type MI.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

- A. Above Accessible Ceilings: Building wire in raceways. Low voltage cable (less than 100 volts) may be installed without conduit. Low voltage cables in ducts, plenums and other air-handling spaces shall be plenum listed. Whips to individual luminaires on non-essential circuits.
- B. All Other Locations: Building wire in raceway.
- C. Above Grade: All conductors installed above grade shall be type "THHN".
- D. Underground or In Slab: All conductors shall be type "THWN".

3.2 WIRE FOR SPECIALIZED SYSTEMS

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed:
 - 1. Fire alarm
 - 2. Low voltage switching
 - 3. Nurse call
 - 4. Sound
 - 5. Electronic control
 - 6. Security
 - 7. TV
 - 8. Telephone
 - 9. Data
 - 10. Clock

3.3 CONTRACTOR CHANGES

- A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC Table 310.16. Service entrance conductors are based on copper conductor installed in underground electrical ducts, NEC Table B.310.15(B)(2)(7).
- B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of design.
- C. Underground electrical duct ampacity rating shall be in accordance with NEC Table B.310.15(B)(2)(7) or calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.
- D. Record drawing shall include the calculations and sketches.

3.4 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use no wire smaller than 18 AWG for low voltage control wiring (<100 volts).

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- C. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
 - D. Use no wire smaller than 8 AWG for outdoor lighting circuits.
 - E. The ampacity of multiple conductors in one conduit shall be derated per National Electrical Code, Article 310. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.
 - F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.
 - G. Splice only in junction or outlet boxes.
 - H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - I. Make conductor lengths for parallel circuits equal.
 - J. All conductors shall be continuous in conduit from last outlet to their termination.
 - K. Terminate all spare conductors on terminal blocks, and label the spare conductors.
 - L. Cables or wires shall not be laid out on the ground before pulling.
 - M. Cables or wires shall not be dragged over earth or paving.
 - N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
 - O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
 - P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.5 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially thru raceway.
- D. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not made where the wire may be permanently stretched and the insulation damaged.
- F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- G. Completely and thoroughly swab raceway system before installing conductors.

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- H. Conductor Supports in Vertical Raceways:
 - 1. Support conductors in vertical raceways in accordance with NEC 300.19 and Table 300.19(A) Spacing of Conductors Supports.
 - 2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting installed in an accessible junction box (Hubbell Kellems support grip or equal).

3.6 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Use suitable cable fittings and connectors.
- C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", recognized industry standards; and coordinated with other contractors.
- D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables. J-hooks shall be Caddy CAT or Mono Systems H-433 series.
- E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.
- F. J-hook supports shall be installed at a maximum of five-foot (5') intervals. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.
- G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these specifications.

3.7 FIRE-RATED CABLE INSTRUCTIONS

- A. Terminations of the fire-rated cable must be outside of the fire zone.
- B. Fire-rated cable shall be installed according to the manufacturer's recommendations.

3.8 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for copper conductor terminations, 8 AWG and larger.
- C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor terminations, 10 AWG and smaller.
- D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

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- E. Use copper, compression connectors applied with circumferential crimp for copper wire splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
 - F. Thoroughly clean wires before installing lugs and connectors.
 - G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
 - H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
 - I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
 - 1. Facing the front and operating side of the equipment, the phase identification shall be:
 - a. Left to Right - A-B-C
 - b. Top to Bottom - A-B-C
 - J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.

3.9 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 1.
- B. Building Wire and Power Cable Testing: Test shall be made by means of an insulation testing device such as a "Megger" using not less than 500 volts D.C. test potential.
- C. Inspect wire and cable for physical damage and proper connection.
- D. Torque test conductor connections and terminations to manufacturers recommended values.
- E. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.
- F. Provide documentation of the manufacturer's recommended lug torque value for conductors, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.
- G. Protection of wire and cable from foreign materials:
 - 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.
- H. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed.
- I. The following restrictions detail methods and material that are not acceptable even if allowed under NEC:
- J. Aluminum or aluminum-clad conductors are not acceptable.

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- K. Shared Neutrals between different branch circuits or other wiring are not acceptable.
 - L. Field-marking of cables is not acceptable. All wires need to be in manufactured color.
 - M. Use of grounded circuit conductors metal conduit, raceway or cable trays as sole grounding conductor is not acceptable. A separate grounding wire is required.
 - N. Omission of bonding jumpers in boxes, and omission of grounding/bonding wires in metal raceways and conduit is not acceptable.
 - O. Underground wiring without conduit or raceway is not acceptable.
 - P. Underground wiring less than 24" deep regardless of concrete pads is not acceptable.
 - Q. Exposed insulation is not acceptable.
 - R. Sizing of conductors at 100% of continuous load only is not acceptable. Conductors shall be sized without the code-allowed exceptions for overcurrent devices rated for operation at 100% of its rating.
 - S. Electric Nonmetallic Tubing (ENT) is not acceptable.
 - T. Open wiring on insulators is not acceptable.
 - U. Overhead wiring without messenger support is not acceptable.
 - V. Cast metal, split or gland type fittings are not acceptable.

END OF SECTION 26 05 13

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment grounding system
- B. Bonding system
- C. Grounding electrode system

1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 Grounding and Bonding Equipment.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- D. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE/ANSI C2 National Electrical Safety Code (NESC).

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 26 05 00.
- B. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical electrodes.
- C. Field Test Reports: Submit written test reports to include the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Indicate layout of ground field, location of system grounding electrode connections, and routing of grounding electrode conductor and ground ring.

1.4 SUMMARY

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section 26 05 13 "Wire and Cable".
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.

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- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
 - E. Grounding Electrode Conductors: Stranded cable.
 - F. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
 - G. Sizes and types below are typical. Adjust to suit Project conditions and requirements.
 - H. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - I. **[GB]:** Grounding Bus:
 - 1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4" x 2", length of electrical room.
 - J. **[IBT]:** Intersystem Bonding Termination:
 - 1. Copper bar, 1/4" x 2" x 24". Provide with wall mounting brackets, insulators and pre-tapped holes.
 - 2. Approved Manufacturers: Harger GBI Series, Erico B544 Series.

2.2 CONNECTOR PRODUCTS

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Hydraulic compression type or exothermic-welded type, in kit form, and selected per manufacturer's written instructions.
- C. Bolted Connectors: Bolted-pressure-type connectors.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

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2. Make connections with clean, bare metal at points of contact.
 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
 - C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
 - D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
 - E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
 - F. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to provide physical protection.
 - G. Underground Connections: Exothermic-welded connections or hydraulic compression connection. Use for underground connections, except those at test wells.
 - H. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
 - I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
- C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride conduit (PVC) in exposed locations.
- D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- E. In raceways, use insulated equipment grounding conductors.
- F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

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- G. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

3.3 EQUIPMENT GROUNDING SYSTEM

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.

3.4 BONDING SYSTEM

- A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side of the expansion joint.
- B. Isolated Equipment Enclosure: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate equipment bonding conductor.
- C. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.
- D. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.
- E. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- F. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.
- G. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.
- H. Terminal Cabinets: Terminate bonding conductor on cabinet grounding terminal.
- I. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

3.5 GROUNDING ELECTRODE SYSTEM

- A. Ground Ring (Counterpoise):
 - 1. Ground the steel framework of the building with a driven ground rod at the base of every corner column and at intermediate exterior columns at average distances not more than 60 feet (18 m) apart. Provide a grounding conductor, electrically connected to each ground rod and to each steel column, extending around the perimeter of the building. Use tinned-copper conductor not less than No. 2 AWG for ground ring and for tap to building steel. Bury conductor not less than 30 inches (760 mm) below grade, 24 inches (600 mm) from building foundation, and 18 inches (459 mm) outside of roof drip line.
- B. Supplementary Grounding Electrode: Use driven ground rod on exterior of building.
- C. Provide bonding at Utility Company's metering equipment and pad mounted transformer.

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- D. Ground Rods: Install at least two rods spaced at least 20 feet from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
 - E. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - F. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
 - G. Bond each aboveground portion of natural gas metallic piping system at equipment locations. The equipment grounding conductor may serve as the bonding means.
 - H. Concrete-Encased Grounding Electrode (Ufer): Install concrete-encased grounding electrode encased in at least 2 inches (50mm) of concrete horizontally within the foundation that is in contact with the earth. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.6 CONCRETE OR WOOD BUILDING GROUNDING SYSTEM

- A. Provide a copper common grounding electrode conductor for the attachment of multiple separately derived systems in accordance with NEC 250.30(A)(4)(a) through 250.30(A)(4)(c). Individual grounding conductor taps from the separately derived systems to the common grounding electrode shall be sized in accordance with NEC 250.66. All tap connections shall be made in an accessible location in such a manner that common grounding electrode conductor remains without a splice or joint.

3.7 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
 - 1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.
 - 2. Testing: Perform the following field quality-control testing:
 - a. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
 - b. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests, by the fall-of-potential method according to IEEE 81.

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- c. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
 - 1) Equipment Rated 500 kVA and Less: 10 ohms.
 - 2) Equipment Rated 500 to 1000 kVA: 5 ohms.
 - d. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect/Engineer promptly and include recommendations to reduce ground resistance.

3.8 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2. Maintain restored surfaces. Restore disturbed paving.

END OF SECTION 26 05 26

SECTION 26 05 27 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports
- B. Fastening hardware
- C. Concrete housekeeping pads

1.2 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.3 COORDINATION

- A. Coordinate size, shape and location of concrete pads with Section on Cast-in-Place Concrete or Concrete Topping.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Allied Support Systems
- B. Cooper B-Line
- C. Erico, Inc.
- D. Hilti
- E. Power Fasteners

2.2 MATERIAL

- A. Support Channel: Hot-dip galvanized or stainless steel for wet/damp locations; painted steel for interior/dry locations. All field cut ends shall be touched up with matching finish to inhibit rusting.
- B. Hardware: Corrosion resistant.
- C. Anchorage and Structural Attachment Components:
 - 1. Strength: Defined in reports by ICBO Evaluation Service or another agency acceptable to Authorities Having Jurisdiction.
 - a. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
 - 2. Through Bolts: Structural type, hex head, high strength. Comply with ASTM A 325.
 - 3. Welding Lugs: Comply with MSS-SP-69, Type 57.
 - 4. Beam clamps for Steel Beams and Joists: Double sided. Single-sided type is not acceptable.
 - 5. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
 - 6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

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7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in cracked concrete by ACI-355.2.
 8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

D. Conduit Sleeves and Lintels:

1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors, unless specifically shown as being by others.
2. Refer to Structural General Notes for lintel requirements in masonry construction.
3. Fabricate all lintels from structural steel shapes or as indicated on the drawings. All lintels and grouped wall openings shall be approved by the Architect or Structural Engineer.
4. Fabricate all sleeves from standard weight black steel pipe. Provide continuous sleeve. Cut or split sleeves are not acceptable. Sleeves through concrete walls may be high density polyethylene pipe penetration sleeve with a water stop collar, suitable for use with Link-Seal mechanical seals. Century-Line Model CS.
5. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
6. Sleeves shall not penetrate structural members without approval from the Structural Engineer.
7. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
8. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
9. Where conduits rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
10. Size sleeves large enough to allow expansion and contraction movement.

E. Concrete Housekeeping Pads:

1. Concrete bases for all floor mounted equipment and wall mounted equipment which is surface mounted and extends to within 6" of the finished floor, unless shown otherwise on the drawings, shall be 3-1/2" thick concrete.
2. Bases shall extend 3" on all sides of the equipment (6" larger than factory base).
3. Where the base is less than 12" from a wall, the base shall be carried to the wall to prevent a "dirt-trap".

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4. Concrete materials and workmanship required for the Contractor's work shall be provided by him. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.

F. Rooftop Support System:

1. Provide pre-fabricated roof supports for all conduit and equipment installed above the roof. Support all conduit and equipment a minimum of 4" above roof.
2. Support system shall be compatible with single ply, bituminous, metal, and spray foam roof systems. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.
3. All metal components shall be hot dipped galvanized. Mounting hardware shall be stainless steel or hot dipped galvanized. Support shall be UV, corrosion, and freeze/thaw resistant. Support shall include orange paint, reflective safety orange accents, or similar markings for increased visibility.
4. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy Pyramid 50, 150, 300, or 600 (to match load).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- C. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- D. Do not use powder-actuated anchors without specific permission.
- E. Do not drill structural steel members.
- F. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- G. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.
- H. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting.
- I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- J. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- K. Refer to Section 26 05 33 for special conduit supporting requirements.

3.2 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
- B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

END OF SECTION 26 05 27

SECTION 26 05 33 - CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metallic conduit and fittings
- B. Intermediate metallic conduit and fittings
- C. Electrical metallic tubing and fittings
- D. Flexible metallic conduit and fittings
- E. Liquidtight flexible metallic conduit and fittings
- F. Rigid polyvinyl chloride conduit and fittings
- G. High density polyethylene conduit and fittings
- H. Wall and ceiling outlet boxes
- I. Electrical connection
- J. Pull and junction boxes
- K. Rough-ins
- L. Handholes
- M. Accessories

1.2 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
 - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
 - 4. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated
 - 5. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
 - 6. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
 - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
 - 2. A-A-55810 - Specification for Flexible Metal Conduit
- C. NECA "Standards of Installation"
- D. National Electrical Manufacturers Association (NEMA):
 - 1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - 2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - 3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
 - 4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC)
- F. Underwriters Laboratories (UL): Applicable Listings
 - 1. UL 1 - Flexible Metal Conduit
 - 2. UL 6 - Rigid Metal Conduit
 - 3. UL 360 - Liquid Tight Flexible Steel Conduit
 - 4. UL514-B - Conduit Tubing and Cable Fittings
 - 5. UL651-A - Type EB and a PVC Conduit and HDPE Conduit
 - 6. UL651-B - Continuous Length HDPE Conduit

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7. UL746A – Standard for Polymeric Materials – Short Term Property Evaluations
 8. UL797 – Electrical Metal Tubing
 9. UL1242 – Intermediate Metal Conduit

G. American Standard of Testing and Materials (ASTM):

1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position
4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material

H. Definitions:

1. Fittings: Conduit connection or coupling.
2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.
6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
7. Slab: Horizontal pour of concrete used for the purpose of a floor or sub-floor.

1.3 SUBMITTALS

- A. Include fittings and conduits 1.5" and larger in coordination files. Include all in-floor and underfloor conduit in coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Acceptable Manufacturers:

1. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.
2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.

- B. Minimum Size Galvanized Steel: 3/4 inch (19mm), unless otherwise noted.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

- D. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a complete encapsulated system. Acceptable Manufacturers: Robroy, T&B Ocal or approved equal.

2.2 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

- B. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.

C. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.

- B. Acceptable Manufacturers of EMT Conduit: Allied, LTV, Steelduct, Wheatland Tube Co, or approved equal.

C. Fittings and Conduit Bodies:

1. 2" Diameter or Smaller: Compression or steel set screw type of steel designed for their specific application.

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2. Larger than 2": Compression or steel set screw type of steel designed for their specific application.
 3. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline, Raco, Bridgeport, Midwest, Regal, Thomas & Betts, or approved equal.

2.4 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- B. Acceptable Manufacturers: American Flex, Alflex, Electri-Flex Co, or approved equal.
- C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment grounding conductor when used for equipment where flexibility is required.
- D. Fittings and Conduit Bodies:
 1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.
 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
 3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, Electroline, Bridgeport, Midwest, Regal, or approved equal.

2.5 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

- A. Acceptable Manufacturers: Anaconda Type UA, Electri-Flex Type LA, Alflex, Carlon (Lamson & Sessions), or approved equal.
- B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.
- C. Fittings and Conduit Bodies:
 1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
 3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas & Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

2.6 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

- A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers: Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or approved equal.
- C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.
- D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.
- E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.7 HIGH DENSITY POLYETHYLENE

- A. Minimum Size: 2 inch, unless noted otherwise.
- B. Acceptable Manufacturers: Carlon, Chevron Phillips Chemical Company, or approved equal.
- C. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the following resin properties:

ASTM Test	Description	Values HDPE
D-1505	Density g/CM 3	< .941
D-1238	Melt Index, g/10 min Condition E	> .55 grams/10 min.
D-638	Tensile Strength at yield (psi)	3000 min.
D-1693	Environmental Stress Crack Resistance Condition B, F 20	96 hrs.
D-790	Flexural Modulus, MPa (psi)	< 80,000
D-746	Brittleness Temperature	-75°C Max

- D. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may affect the wall integrity.
- E. Fitting and Conduit Bodies:
 - 1. Directional Bore and Plow Type Installation: Electrofusion or Universal Aluminum threaded couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.
 - 2. For all other type of installation: Coupler must provide a water tight connection. The tensile strength of coupled pipe must be greater than 1,000 lbs.
 - 3. E-loc type couplings are not acceptable in any situations.
 - 4. Acceptable Manufacturers: ARCON, Carlon, or approved equal.

2.8 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2 inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: NEMA FB1, Type FD, Aluminum or cast ferrous alloy, deep type, gasketed cover, threaded hubs.
- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.
- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.
- F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.

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- G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.9 **[ECONN]: ELECTRICAL CONNECTION**

- A. Electrical connection to equipment and motors, sized per NEC. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.10 **[JB]: PULL AND JUNCTION BOXES**

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components: Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and electrical components.
- C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- E. Flanged type boxes shall be used where installed flush in wall.

2.11 **ROUGH-IN**

- A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,
- B. Conduit routed to the corridor cable tray.
- C. **[RI-TECH]: Technology Rough-in:**
 - 1. Rough-in shall have one (1) 1" conduit.
- D. **[RI-TECH-W]: Technology Rough-in - Wall Phone:**
 - 1. Mount on wall +54" or as noted in plans. Rough-in shall have one (1) 1" conduit.
- E. **[RI-TV]: Television Antenna Outlet Box Rough-in:**
 - 1. Rough-in shall have one (1) 3/4" conduit.

2.12 **HANDHOLES**

- A. **[HH-1]: Handhole, composite polymer concrete body and cover. Stainless steel hardware. Bolted non-skid cover rated for 10,000 pounds. Design load occasional non-deliberate vehicular traffic. Stack units to achieve depth shown on plans. Units in landscaped areas shall be green in color. 11"W, 18"L, 18"D or dimensions as shown on plans.**
 - 1. Approved Manufacturers:
 - a. Hubbell/Quazite PG####BB18, PG####HA00
 - b. Carson Industries H Series
 - c. Armorcast
 - d. Highline Products
 - e. Synertech

2.13 ACCESSORIES

- A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back boxes. Kinetics Noise Control – IsoBacker Pad, SpecSeal – SSP Putty and Pads, 3M #MPP-4S or equal.
- B. Sound Barrier Insulation Pads: Mastic, non-hardening, sheet material, minimum 1/8" thickness applied to all five sides of back boxes. Kinetics Noise Control – SealTight Backer Pad, L.H. DOTTIE Co., #68 or equal.

PART 3 - EXECUTION

3.1 INSTALLATION TRAINING

- A. PVC coated rigid metal conduit and reinforced thermosetting resin conduit (RTRC) manufacturers shall provide Contractor installation training for field cutting, joint preparation, joint assembly, field bending, and field cut sealing.

3.2 CONDUIT SIZING

- A. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to NEC. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the NEC (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- B. Minimum Conduit Size (Unless Noted Otherwise):
 - 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
 - 2. Below Grade 5' or less from Building Foundation: 3/4 inch.
 - 3. Below Grade More than 5' from Building Foundation: 3/4 inch.
 - 4. Telecommunication Conduit: 1 inch.
 - 5. Controls Conduit: 1/2 inch.
- C. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.3 CONDUIT ARRANGEMENT

- A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.
- B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.
- C. Conduit shall not share the same cell as structural reinforcement in masonry walls.

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- D. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown diagrammatically shall be chosen by the Contractor based on information in the contract documents, in accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", in accordance with recognized industry standards, and coordinated with other contractors.
 - E. Contractor shall adapt his work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
 - F. Contractor shall cooperate with all Contractors on the project. He shall obtain details of other Contractor's work in order to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by him. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.4 CONDUIT SUPPORT

- A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1-1/2" 1" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
- F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps. Provide space in each rack or trapeze for 25% additional conduits.
- G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.
- I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the NEC requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
- J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.
- K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the NEC requirements.

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- L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.
 - M. Finish:
 - 1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above suspended ceiling spaces are not considered exposed.
 - 2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of finish floor and presents potential injury to personnel.

3.5 CONDUIT INSTALLATION

- A. Conduit Connections:
 - 1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
 - 2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust inhibitor primer applied after the connection is made.
 - 3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
 - 4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
- B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.
- C. Conduit Bends:
 - 1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
 - 2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
 - 3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°), including those bends located immediately at the outlet or body.
 - 4. Telecommunications conduits shall have no more than two (2) 90 degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.
 - a. A third bend is acceptable if:
 - 1) The total run is not longer than (33) feet.
 - 2) The conduit size is increased to the next trade size.
 - 5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter into the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
 - 6. Telecommunications conduit bend radius shall be six (6) times the diameter for conduits under 2" and ten (10) times the diameter for conduits over 2".

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7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
 8. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the NEC.
2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or less than 1.5" below bottom of roof decking.
5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty, or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests or through-penetration fire stops as manufactured by 3M or approved equal.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, equal to O-Z/Gedney type EYD.
9. Horizontal conduit routing through slabs above grade:
 - a. No conduits are allowed to be routed horizontally through slabs above grade.
10. Do not route conduits across each other in slabs on grade.
11. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and ambient temperature are greater than 40°F.
12. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits earth. The metallic conduit shall extend a minimum of 6" into the surface concealing the non-metallic conduit.
13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.

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14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty conduit (indoor and outdoor), except in sleeves and nipples.
 15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).
 16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
 17. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.6 CONDUIT TERMINATIONS

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, or approved equal.
- B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut and bushing on the inside of each box.
- C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
- E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise. Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the NEC, shall be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length. Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.
- F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.
- G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of any and all foreign matter prior to any wires or pull cords being installed.

3.7 UNDERGROUND CONDUIT INSTALLATION

- A. Conduit Connections:
 1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.
- B. Conduit Bends (Lateral):
 1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.

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2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.
- C. Conduit Elbows (vertical):
1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (>600V) and 18 inches for secondary conduits (<600V). Increase radius, as required, based on pulling tension calculation requirements.
- D. Conduit Placement:
1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.
 2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.
 3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum f'c = 2500 and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.
 4. Before the Contractor pulls any cables into the conduit he shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.
 5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.
 6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.
 7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.
 8. All non-metallic conduit installed underground outside of a slab shall be rigid.
- E. Horizontal Directional Drilling:
1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
 2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.
- F. Raceway Seal:
1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceway shall also be sealed.

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2. All telecommunications conduits and innerducts, including those containing cables, shall be plugged at the building and vault with "JackMoon" or equivalent duct seal, capable of withstanding a 10 foot head of water (5 PSI).

3.8 CONDUIT INSTALLATION SCHEDULE

A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If This Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the NEC shall be required.

B. The following schedule shall be adhered to unless they constitute a violation of applicable codes or are noted otherwise on the drawings. The installation of RMC conduit will be permitted in place of any and all conduit specified in this schedule.

1. Exposed:
 - a. Switchboards, panel feeders, etc.: EMT.
 - b. Branch Circuits (lighting, receptacles, controls, etc.): EMT.
 - c. Mechanical Equipment Feeders (pumps, AHU's, chillers, etc.): EMT.
 - d. Floor Mounted Pump Feeders: EMT with no more than 6' of PVC coated flexible metal conduit to pump.
 - e. Controls: EMT painted blue or dyed blue.
2. Finished Spaces/Concealed: EMT.
3. Wet or Damp Locations: RMC conduit, boxes and fittings, installed and equipped so as to prevent water from entering the conduit system.
4. Corrosive Locations: PVC Coated Rigid Metal conduit, boxes and fittings installed and equipped so as to prevent water from entering the conduit system.
5. In or Under Slabs on Grade:
 - a. Within 5' from the perimeter of the building: RMC
 - b. Within 5' from the perimeter of the building when passing through the perimeter of the building foundation: RMC.
6. Site Conduits:
 - a. Within 5' from the Perimeter of a Building Foundation: RMC.
 - b. 5' or Greater from the Perimeter of a Building Foundation: PVC.
 - c. Under Roads, Drives, and Vehicle Traveled Ways: Concrete encased PVC with a minimum of 3" concrete cover on all sides of conduit.
 - d. Reinforcing shall consist of one-half inch deformed bars spaced 12 inches on center, paralleling the ducts on bottom, with one-half inch deformed tie bars spaced twelve inches on centers.
 - e. Bars shall overlap forty (40) diameters and shall extend 5' beyond roads, drives, traveled ways, etc.

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- f. Provide minimum 3" concrete cover on all sides of reinforcing.
 - g. Entire ductbank shall be installed on precast concrete pavers on 3' centers.
7. Interior Locations:
- a. Exposed: EMT conduit.
 - 1) Exposed Controls Conduit: EMT painted blue or dyed blue.
 - b. Concealed: EMT.
8. Hazardous Locations as Defined by the NEC: RMC conduit complete with screwed fittings and conduit seals.

3.9 BOX INSTALLATION SCHEDULE

- A. Galvanized steel boxes may be used in:
- 1. Concealed interior locations above ceilings and in hollow studded partitions.
 - 2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
 - 3. Direct contact with concrete except slab on grade.
 - 4. Recessed in stud wall of kitchens and laundries.
- B. Cast boxes shall be used in:
- 1. Exterior locations.
 - 2. Hazardous locations.
 - 3. Exposed interior locations within 8' of the highest platform level.
 - 4. Direct contact with earth.
 - 5. Direct contact with concrete in slab on grade.
 - 6. Wet locations.
 - 7. Kitchens and laundries when exposed on wall surface.

3.10 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.
- E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.11 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls.
 - 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

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2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
- B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.
 - C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)
 - D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
 - E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
 - F. Provide knockout closures for unused openings.
 - G. Support boxes independently of conduit.
 - H. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
 - I. Install boxes in walls without damaging wall insulation.
 - J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.
 - K. Position outlets to locate luminaires as shown on reflected ceiling drawings.
 - L. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
 - M. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
 - N. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
 - O. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.
- 3.12 PULL AND JUNCTION BOX INSTALLATION
- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
 - B. Support pull and junction boxes independent of conduit.
 - C. Do not install boxes back-to-back in walls.
 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation pads on all five sides of the back box in accordance with the manufacturer's instructions.

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2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product. Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product carries the necessary fire rating.
 - D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3.13 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION 26 05 33

SECTION 26 05 35 - SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Multi-outlet assemblies

1.2 REFERENCES

- A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 26 05 00.
- B. Include product data for surface metal raceways, multi-outlet assemblies, surface non-metallic raceways, auxiliary gutters, and accessories.

PART 2 - PRODUCTS

2.1 **[WM]:** MULTI-OUTLET ASSEMBLY

- A. Multi-outlet Assembly: FS W-C-582; sheet metal channel with fitted cover, with pre-wired receptacles, suitable for use as a multi-outlet assembly. Surface mount.
- B. Receptacles: Convenience receptacle mounted in cover 20 inches on center. Receptacles shall be 15 amp, 125 volt, 3-wire, grounding type, specification grade. Single circuit type.
- C. Finish: Stainless steel.
- D. Fittings: Couplings, elbows, outlet and device boxes, and connectors designed for use with multi-outlet system. Provide all miscellaneous fittings for an electrically and mechanically continuous system.
- E. Acceptable Manufacturers: Wiremold 2000 series, Mono-Systems 1900 series, Hubbell HBL2000 series.

PART 3 - EXECUTION

3.1 INSTALLATION - SURFACE METAL RACEWAY AND MULTI-OUTLET ASSEMBLY

- A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.
- B. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
- C. Maintain grounding continuity between raceway components to provide a continuous grounding path.
- D. Fastener: Use clips and straps suitable for the purpose.
- E. Field cuts to be clean and straight and use the proper tools as recommended by the system manufacturer to prohibit damage to factory finish or raceway. Joints to be matched so there are no gaps or spaces in the cover. Furnish and install manufacturer's raceway accessories as needed.

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- F. Provide conduits to technology raceway per drawings or provide a minimum of one (1) 1-1/4" conduit per six feet of assembly (minimum 2) to above ceiling for technology requirements if assembly has technology raceway (Contractor shall provide quantities of conduits that provide maximum capacity to assembly). Provide conduits equally spaced within entire length of assembly.

 - G. Provide one (1) 3/4" empty conduit per six feet of assembly (minimum 1) to above ceiling for future power needs. Provide conduits equally spaced within entire length of assembly.

END OF SECTION 26 05 35

SECTION 26 05 36 - CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cable trays
- B. Cable tray accessories

1.2 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of cable tray and cable channel systems (Article 392, NEC).
- B. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.3 REFERENCES

- A. ANSI/NFPA 70 – National Electrical Code
- B. ASTM A123 – Specification for Zinc (Hot Galvanized) Coatings on Iron and Steel
- C. ASTM A510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- D. ASTM B633 – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- E. NEMA VE 1 – Metallic Cable Tray Systems
- F. NEMA VE 2 – Cable Tray Installation

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Indicate tray type, dimensions, support points, clamps, hangers, connectors, fittings, expansion joint assemblies, accessories and finishes.
- C. Submit manufacturer's installation instructions under provisions of Section 26 05 00.
- D. Include cable tray in composite electronic coordination files. Refer to Section 26 05 00 for coordination drawing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging.
- B. Store materials in a dry area indoors, protecting from damage and in accordance with manufacturer's instructions.

1.6 TESTING AND COMMISSIONING

- A. Visually inspect each cable tray ground connection for mechanical continuity.
- B. Visually inspect each structural suspension point for specified loading and spacing.
- C. Submit notification of testing and results under provisions of Section 26 05 00.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Include cleaning and bolt-tightening procedures.
- C. Note grounding point on as-built drawings.

1.8 COORDINATION

- A. Coordinate layout and installation of cable trays and suspension system with other construction, including structural members, light fixtures, HVAC equipment, fire suppression systems, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all cable tray with all fittings and mounting hardware. Install according to NEMA class with 1.5 safety factor.
- B. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- C. Refer to manufacturers installation instructions and specific product data below for additional information.
 - 1. Approved Manufacturers: Cooper B-Line Series 35, Cope, Thomas & Betts, Mono-Systems Inc.
 - 2. Manufacturers: Cooper B-Line Channel CC Series, Cope, Thomas & Betts.

2.2 WELDED WIRE MESH CABLE TRAYS

- A. [CT-#]: Wire mesh type cable tray, 4" loading depth, width indicated on plans. Provide trapeze support with plastic retainer.
 - 1. Approved Manufacturers: B-Line, Mono-Systems, Cope, Cablofil Inc., Hubbell HBT.
- B. Tray: Continuous, rigid, welded steel wire mesh cable tray with continuous top wire safe edge with T-weld.
- C. Wire mesh shall be welded at all intersections.
- D. Material: Carbon steel wire, 0.197" minimum wire diameter, ASTM A510, Grade 1008. Wire shall be welded, formed and surface treated.
- E. Finish: Finish shall be applied after welding and bending of mesh. Finish shall be electro-plated zinc galvanizing: ASTM B633, Type I, SC-1.
- F. Provide grounding clip for continuous grounding of tray.
- G. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, and miscellaneous hardware as required for a complete and functioning installation to manufacturer's recommendations.
- H. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

2.3 WARNING SIGNS

- A. Provide manufacturer's standard, permanent, legible warning label indicating the following:

WARNING! DO NOT USE AS A WALKWAY, LADDER, OR SUPPORT FOR PERSONNEL. TO BE USED ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!
- B. Label shall also indicate cable tray NEMA load class. Label shall be a maximum of 10' on center.
- C. Cable trays containing conductors rated over 600 volts shall have a label with the wording "DANGER-HIGH VOLTAGE-KEEP AWAY".
- D. Cable trays containing service entrance conductors shall be labeled with "CABLE TRAY CONTAINS SERVICE-ENTRANCE CONDUCTORS".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: In conformance with NEMA VE 2 requirements and in accordance with manufacturer's instructions.
- B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft. maximum.
- C. Use expansion connectors where indicated in NEMA VE 1.
- D. Cut standard straight sections to length in field.
- E. Tray shall be electrically continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without support.
- F. Tray shall be field cut using the manufacturer's approved cutting device and methods. Cutting device shall be an offset blade bolt cutter. The use of standard bolt cutters is strictly prohibited.
- G. Bends in tray shall be accomplished by utilizing manufacturer's cutting guides.
- H. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.
- I. Provide bonding continuity between cable tray sections, fittings and conduit terminations in accordance with manufacturer's instructions.
- J. Tighten electrical connectors and terminals per manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- K. Remove burrs and sharp edges from cable trays.
- L. Seal penetrations through fire and smoke barriers.
- M. Install capped sleeves for future cables through firestop sealed cable tray penetrations of fire and smoke barriers as shown on drawings.
- N. Install cable trays with sufficient space to permit access for installing cables. Install tray bottom within 18" of access ceiling paneling for ease of access. Adjust mounting height only momentarily for field coordination with other trades and systems as required.

-
- O. Provide separation of cables of different systems, such as power, telecommunications, fire alarm system, security systems and audio or visual systems. Install barriers between power and low voltage cables.

END OF SECTION 26 05 36

SECTION 26 05 42 - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment specified under other Sections or furnished by the Owner.

1.2 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices
- B. NEMA WD 6 - Wiring Device Configurations
- C. ANSI/NFPA 70 - National Electrical Code

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

- A. Straight-blade Attachment Plug: NEMA WD 1.
- B. Locking-blade Attachment Plug: NEMA WD 5.
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil-resistant thermoset insulated Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit over-current protection.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.
- B. Make cord connections to equipment using flexible conduit. Use liquidtight flexible conduit in damp or wet locations.
- C. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- D. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.

-
- E. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
 - F. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.
 - G. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

END OF SECTION 26 05 42

SECTION 26 05 53 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and tape labels
- B. Wire and cable markers
- C. Conduit labeling
- D. Conduit color coding
- E. Conductor color coding
- F. Electrical gear labeling
- G. Power distribution equipment labeling
- H. Transformer equipment labeling
- I. Series rating identification
- J. Pole identification

1.2 REFERENCES

- A. ANSI C2 – National Electrical Safety Code
- B. NFPA 70 – National Electrical Code
- C. ANSI A13.1 – Standard for Pipe Identification
- D. ANSI Z535.4 – Standard for Product Safety Signs and Labels

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.
- B. Pretensioned Flexible Wraparound Colored Plastic Sleeves for Cable Identification: flexible acrylic bands sized to suit the cable diameter and arranged to stay in place by pre-tensioned gripping action when coiled around the cable.
- C. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.
- D. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.
- E. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.
- F. Aluminum, Wraparound Marker Bands: 1" in width, .014 inch thick aluminum bands with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- G. Brass or aluminum Tags: 2" by 2" by .05-inch metal tags with stamped legend, punched for fastener.

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- H. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label, minimum of 3/4" high x 9/16" wide, with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

2.2 NAMEPLATES AND SIGNS

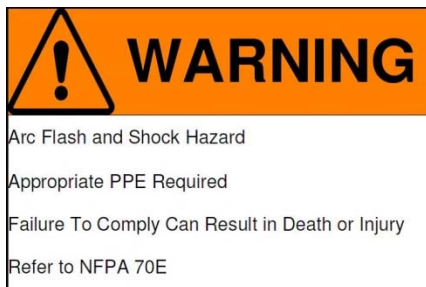
- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners. Engraving legend shall be as follows:
 - 1. Black letters on white face for normal power.
 - 2. White letters on red face for emergency power.
 - 3. White letters on green face for grounding.
 - 4. Black letter on yellow face for Caution or UPS.
- B. Baked-Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with colors, legend, and size required for application. Mounting ¼" grommets in corners.
- C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with .0396 inch galvanized-steel backing: and with colors, legend, and size required for application. Mounting ¼" grommets in corners.
- D. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- E. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.
- B. Install identification devices in accordance with manufacturer's written instruction and requirements of NEC.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.
- D. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape or Brother self-laminating vinyl label, or permanent magic marker (color coded), neatly hand printed. In rooms that are painted out, provide labeling on inside of cover.
- E. Circuit Identification: Tag or label conductors as follows:
 - 1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
 - 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.

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3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- F. Apply warning, caution and instruction signs as follows:
1. Install warning, caution or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- I. Install ARC FLASH WARNING signs on all switchboards, panelboards, industrial control panels, and motor control centers. Sign at a minimum shall contain:



- J. Circuits with more than 600V: Identify raceway and cable with "DANGER—HIGH VOLTAGE" in black letters 2 inches high on orange background at 10'-0 foot intervals.
1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to conduits concealed within wall.
 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building, or concealed above suspended ceilings.
- K. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.

3.2 SWITCH AND RECEPTACLE COVER PLATES

- A. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit number serving the device (i.e. "C1A #24").
- B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters in normal size "Swiss 721 Bold" font. Letter and number size to 3/16-inch high. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.

3.3 BOX LABELING

- A. All junction, pull, and connection boxes shall be identified as follows:
 - 1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").
 - 2. For other wiring, indicate system type and description of wiring ("FIRE ALARM NAC #1").
- B. Box covers shall be painted to correspond with system type as follows:
 - 1. Fire Alarm: Red
 - 2. Emergency: Orange
 - 3. Temperature Control/Building Automation: Blue
 - 4. Box color to match conduit color indicated below.

3.4 CONDUIT COLOR CODING SCHEDULE

- A. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:
 - 1. Fire Alarm System: Red.
 - 2. Normal Power Distribution System 277V/480V: Silver. Labeled as "277/480Y"
 - 3. Normal Power Distribution System 120V/208V: Silver. Labeled as "120/208Y"
 - 4. Emergency Power Distribution System: Green, Labeled per Voltage used.
 - 5. Optional Standby: Blue, Labeled per Voltage used.
 - 6. DC Voltage (Solar etc.): Orange, labeled as "600VDC" or per system rating.
 - 7. Temperature Controls, Motor Control and Other Control or Building Automation Systems: White. Labeled as "BAS"
 - 8. Communication (CAT6, Fiber, Access System, Radio, etc.): Purple. Labeled "COM", "FIBER", or as directed by owner.
 - 9. Security System: Yellow.
 - 10. Ground: Green.
- B. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.
- C. This Contractor shall furnish and install framed 8" x 10" charts of the color coded identification scheme used for the electrical system in all electrical rooms and next to the main fire alarm panel.

3.5 CONDUCTOR COLOR CODING

- A. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.
- B. Where more than one nominal voltage system exists in a building or facility, the identification of color coding used in the panelboard or equipment shall be permanently posted on the interior of the door or cover.

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- C. All wires and cables, 6 AWG or larger, used in motor circuits, main feeders, sub-main feeders and branch circuits, shall be coded by the application of plastic tape. The tape shall be 3-M, Plymouth or Permacel, in colors specified below. The tape shall be applied at each conductor termination with two 1-inch tape bands at 6-inch centers. Contractor option to use colored cabling in lieu of the tape at each end for conductor 6 AWG to 500 KCM.
- D. Wire and cables smaller than 6 AWG shall be color coded by the manufacturer.
- E. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal or splice point starting 3 inches from the termination and spaced at 3- inches centers. Tighten to a snug fit, and cut off excess length.
- F. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.
- G. Conductors shall be color coded as follows:
1. 120/240 Volt, 3-Wire:
 - a. A-Phase – Black
 - b. B-Phase – Red
 - c. Neutral – White
 - d. Ground Bond – Green
 2. 208Y/120 Volt, 4-Wire:
 - a. A-Phase – Black
 - b. B-Phase – Red
 - c. C-Phase – Blue
 - d. Neutral – White
 - e. Ground Bond – Green
 3. 480Y/277 Volt, 4-Wire:
 - a. A-Phase – Brown
 - b. B-Phase – Orange
 - c. C-Phase – Yellow
 - d. Neutral – Gray
 - e. Ground Bond – Green
 4. 120 Volt, 2-Wire Isolated (Ungrounded) Power System:
 - a. A-Phase – Orange with distinctive colored stripe other than white, green or gray along the entire length of the conductor
 - b. B-Phase – Brown with distinctive colored stripe other than white, green or gray along the entire length of the conductor
 - c. Ground Reference – Green
 5. 120/208 Volt, 3-Wire, Isolated (Ungrounded) Power System:
 - a. A-Phase – Orange with distinctive colored stripe other than white, green or gray along the entire length of the conductor
 - b. B-Phase – Brown with distinctive colored stripe other than white, green or gray along the entire length of the conductor
 - c. C-Phase – Yellow with distinctive colored stripe other than white, green or gray along the entire length of the conductor
 - d. Ground Reference – Green

3.6 ELECTRICAL GEAR LABELING

- A. Exterior electrical gear shall be identified with vinyl label names and numbers to be visible on the exterior of the gear. The labels shall correspond to the 1-line nomenclature and identify each cubicle of multi-section gear.

3.7 CONTROL EQUIPMENT IDENTIFICATION

- A. Provide identification on the front of all control equipment, such as disconnect switches, starters, VFDs, contactors, motor control centers, etc. Nameplate text shall be a minimum of 1/4" high.
- B. Labeling shall include:
1. Equipment type and contract documents designation of equipment being served.
 2. Location of equipment being served if it is not located within sight.
 3. Voltage and phase of circuit(s).
 4. Panel and circuit number(s) serving the equipment.
 5. Method of automatic control, if included ("AUTO CONTROL BY FCMS").

EXHAUST FAN EF-1 ("LOCATED ON ROOF") 480V, 3-PHASE FED FROM "1HA1-1"
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3.8 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

- A. Provide identification on the front of all power distribution equipment, such as panelboards, switchboards, etc. The identification material shall be engraved plastic-laminated labels. Text shall be a minimum of 1/4" high, Swiss 721 Bold.
- B. Labeling shall include:
1. Equipment type and contract documents designation of equipment.
 2. Voltage of the equipment.
 3. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
 4. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").

DISTRIBUTION PANEL <u>DP-H1</u> 480Y/277V FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELECTRIC ROOM)

- C. A separate nameplate for the service entrance equipment shall be labeled with the MAXIMUM AVAILABLE FAULT CURRENT and DATE of calculation given on the one-line diagram.
- D. Distribution panelboards and switchboards shall have each overcurrent protection device identified with name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1").
- E. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part of the O&M Manuals. Refer to Section 26 05 00 for other requirements.

3.9 TRANSFORMER EQUIPMENT IDENTIFICATION

- A. Provide identification on the front of all transformers. The identification nameplate shall be an engraved plastic-laminated label. Text shall be a minimum of 1/4" high.
- B. Labeling shall include:
1. Equipment type and contract documents designation of equipment
 2. Name of the upstream equipment.
 3. Voltage and rating of the equipment.
 4. Location of the upstream equipment if it is not located within sight.

TRANSFORMER <u>TR-15</u> 480V: 208Y/120V 15KVA FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELECTRIC ROOM)
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3.10 POLE IDENTIFICATION

- A. Lighting poles, bollards and overhead distribution poles shall be individually identified with a unique number, for maintenance purposes. Apply the vinyl label number above the hand hole cover or 24" above grade. Bollards may be identified with a number applied inside the luminaire that is visible from the exterior.

END OF SECTION 26 05 53

SECTION 26 05 73 - POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Low voltage distribution system power study.
- B. Short-circuit analysis and report.
- C. Selective coordination analysis and report.
- D. Arc-flash hazard analysis and report.

1.2 SUBMITTALS

- A. Analyses shall be performed by an agent authorized by the manufacturer of equipment specified in the related specification sections and shall bear the seal/signature of the licensed Professional Engineer who performed the analysis.
- B. The input for the power system study shall be based on the contract documents, with estimated conductor lengths provided by the Electrical Contractor. KJWW Engineering will provide a preliminary Power Tools for Windows project file for information, if requested.
- C. Documentation of the analyses shall be submitted in a bound booklet format and shall accompany the shop drawing submittals for equipment provided under the related work specification sections. These shop drawings will not be reviewed without this documentation. Submit a sample arc-flash hazard label for Owner review and approval prior to printing.
- D. Power system study project model shall be submitted on electronic media for review and the Owner's operating and maintenance records.

1.3 SCOPE

- A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault analysis, selective coordination analysis and arc flash hazard analysis.
- B. Contractor is required to provide a fully coordinated system for the essential electrical system and the associated normal side of each transfer switch and all other locations indicated on the one line diagram. Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units, etc. as required to provide a selectively coordinated system.

PART 2 - PRODUCTS

- 2.1 Power systems study shall be completed in Power Tools for Windows (PTW) 7.0 or later version or pre-approved equivalent program.

PART 3 - EXECUTION

3.1 SHORT-CIRCUIT ANALYSIS

- A. Provide a complete short-circuit analysis from the utility service to and including the entire building distribution as shown on the drawings.
- B. Analysis shall include the entire distribution system from the point of connection to the utility power source to the distribution panels and branch circuit panelboards.

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- C. Documentation shall be made in one-line diagram form showing the magnitude and location of each calculated fault. Fault current calculations shall be made at the main bus of each switchboard, distribution panel, and branch circuit panel. A summary of the fault currents available shall also be submitted.

3.2 SELECTIVE COORDINATION ANALYSIS

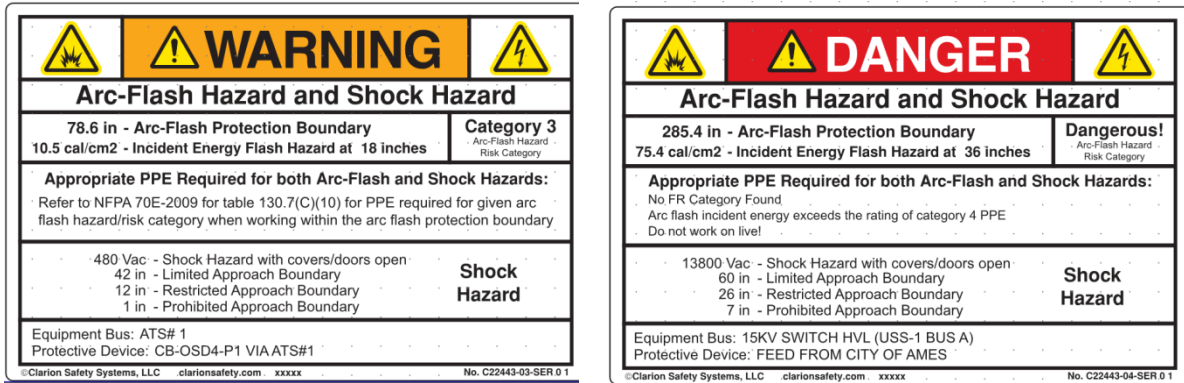
- A. Provide a complete selective coordination analysis, comparing time/current curves of the protective devices to be installed to assure complete selectivity between main and downstream devices for code-required branches and branches identified on one-line drawings. Overcurrent protective devices serving the essential electrical system shall selectively coordinate for the period of time that a fault's duration extends beyond 0.01 second.
- B. The analysis shall include primary protective device, secondary main switchboard device(s), switchboard branch feeder devices, generator breaker, distribution panel, panelboard main devices, and branch feeder devices.
- C. The coordination plots provided shall indicate graphically the coordination proposed for the system on full-size log forms and shall define the types of protective devices selected, together with proposed time dial and pickup settings required. The plots shall include titles, representative one-line diagrams, legend, complete parameters for transformer(s), and complete operating bands for circuit breaker trip devices, fuses, etc.
 - 1. The long-time region of the coordination plots shall designate the pickups required for the circuit breakers.
 - 2. The short-time region shall indicate the magnetizing in-rush and ASA-withstand-transformer parameter, the circuit breaker, short-time and instantaneous trip devices, fuse-manufacturing tolerance bands, significant symmetrical fault currents, etc.
 - 3. Each primary protective device required for the transformer shall be selected so the characteristics or operating band is within the transformer parameters, which shall include a parameter equivalent to 58% of the withstand point to afford protection for secondary line-to-ground faults. The transformer damage curve shall be included for the transformer when the selected protective device is not within the associated parameters.
 - 4. Molded case circuit breakers shall be separated from each other and the associated primary protective device by a 16% current margin for coordination and protection in the event of secondary line-to-line faults.
 - 5. The protective device characteristics or operating bands shall be suitably indicated to reflect the actual symmetrical fault currents sensed by the device.
 - 6. The drawings and specifications indicate the general requirements for motors, motor-starting equipment, and medium-voltage and low-voltage equipment, but additional specific requirements of equipment furnished shall be determined in accordance with the results of the coordination study.
 - a. The study shall include verification of equipment ratings and settings. The Contractor shall keep the study up-to-date with any project changes which affect the study and submit the revised study for review. A final electronic copy shall be submitted with the record drawings.
- D. Provide summary table of adjustable overcurrent protective devices settings for the operating and maintenance manual.

3.3 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

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- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, unit substations, motor-control centers, panelboards, busway, and splitters) where work could be performed on energized parts.
 - C. Safe working distances shall be based on the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
 - D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit analysis and coordination study models. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
 - E. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared, and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
 - F. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3 to 5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
 - G. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
 - H. When performing incident energy calculations on the line side of a main breaker (as required per the above), the line side and load side contributions must be included in the fault calculation.
 - I. Mis-coordination should be checked among all devices within the branch containing the immediate protective device upstream of the calculation location, and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
 - J. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section.
 - K. Where it is not physically possible to move outside the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
 - L. Create and install NFPA 70E compliant labels describing the arc flash hazard level at all switchboards, panelboards, and other locations in the electrical distribution system where work could be performed on energized parts.
 - M. The label shall include the incident energy calculated in the analysis and the hazard category or appropriate personal protective equipment (PPE) required to perform maintenance on the system when energized. Labels shall be vinyl or laminated, with a self-adhesive backing.

N. Examples showing the minimum required information follow:



O. A list of all hazard categories and the corresponding PPE requirements shall be posted in the main electric room, engineering office, or other location. The list shall be plastic laminate or typewritten and housed in a plastic frame.

3.4 ADJUSTMENTS

- A. Manufacturer’s authorized representative or Contractor shall set all adjustable protective devices to values indicated in the approved coordination study.
- B. Wherever the arc flash incident energy exceeds Arc Flash Category 2 (i.e. > 8 cal/cm²), provide options for adjusting breaker trip times, if possible, to reduce energies to Category 2 or below.

3.5 TRAINING

- A. Provide four hours of Owner training to explain the implications of arc-flash requirements and work permit procedure.

END OF SECTION 26 05 73

SECTION 26 20 00 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Arrangement with Utility Company for permanent electric service
- B. Underground service entrance

1.2 RELATED SECTIONS AND WORK

- A. Refer to the One-Line Diagram for additional information.

1.3 QUALITY ASSURANCE

- A. Utility Company: Madison Gas & Electric.
- B. Install service entrance in accordance with Utility Company's rules and regulations.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Submit Utility Company prepared drawings (if applicable).

1.5 SYSTEM DESCRIPTION

- A. System Voltage: 480Y/277 volts, three phase, four-wire, 60 Hertz.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

- A. Meter: Furnished by the Utility Company.
- B. Meter Base: Furnished by the Contractor, as approved by the Utility Company. (Manufacturers: Milbank, Superior, Duncan, or Anchor).
- C. **[MC-#]:** Exterior Mounted Metering Cabinets: Furnished and installed by the Contractor to Utility Company's specifications. Conduit and conductors between metering cabinets and instrumentation shall be by the Contractor. Connections as required by the Utility Company.

2.2 IDENTIFICATION

- A. Provide a permanent plaque or sign denoting all services, feeders, and branch circuits supplying the building or structure and the area served by each. Install plaque or sign at each service disconnecting means.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Make arrangements with Utility Company to obtain permanent electric service to the Project.
- B. Primary distribution equipment and pad-mounted transformers shall be furnished and installed by the Utility Company.

-
- C. Primary conductors shall be furnished, installed, and terminated by the Utility Company. Primary conduit shall be furnished and installed by the Contractor, as shown on the drawings, to the Utility Company's requirements.
 - D. Underground: Install service entrance conduits in concrete envelope from Utility Company's pad mounted transformer to meter cabinet and building service entrance equipment. Utility Company will connect service conductors to transformer secondary lugs.
 - E. Concrete Pad for Transformer: Furnished and installed by the Contractor to Utility Company's specifications.

END OF SECTION 26 20 00

SECTION 26 22 00 - DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Dry type two winding transformers [TR-#]
- B. Dry type isolation transformers [TR-#]
- C. Dry type harmonic mitigating transformers [TR-#]

1.2 REFERENCES

- A. NEMA - ST 1 - Specialty Transformers
- B. NEMA ST 20 - Dry Type Transformers for General Applications
- C. ANSI/IEEE C57.12.01 - General Requirements for Dry Type Distribution and Power Transformers
- D. ANSI/IEEE C57.12.91 - Test Code for Dry Type Distribution and Power Transformers
- E. Department of Energy 10 CFR Part 431 – Energy Conservation Program for Commercial Equipment: Distribution Transformers Energy Conservation Standards; Final Rule.
- F. NEMA TP 2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
- G. NEMA TP 3 - Standard for the Labeling of Distribution Transformer Efficiency

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, loss data, efficiency at 35, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store and protect products under provisions of Section 26 05 00.
- B. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- C. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.1 DRY TYPE TWO WINDING TRANSFORMERS

- A. Dry Type Transformers: NEMA ST 20, factory-assembled, air-cooled dry type transformers; ratings as shown on the drawings. Transformers supplied under this project shall meet the US Department of Energy (DOE) 2016 Efficiency requirements or the most current DOE CFR in effect.

B. Insulation system and average winding temperature rise for rated KVA as follows:

Ratings	Class	Rise (degree C)
Less than 15	185	As shown on the drawings
15 or higher	220	As shown on the drawings

C. Case temperature shall not exceed 40°C rise above ambient at its warmest point.

D. Winding Taps, Transformers Less than 15 KVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

E. Winding Taps, Transformers 15 KVA and Larger: Two (2) 2-1/2% below and two (2) 2-1/2% above rated voltage, full capacity taps on primary winding.

F. Sound Levels: Average audible sound level shall not exceed the values given below when tested to NEMA ST 20 standards:

Equivalent Winding kVA Range	Average Sound Level, Decibels			
	Self-Cooled Ventilated			Self-Cooled Sealed
	K-Factor = 1 K-Factor = 4 K-Factor = 9	K-Factor = 13 K-Factor = 20	Forced Air w/ Fans Running	
0-9	40	40	67	45
9.01-30.00	45	45	67	50
30.01-50.00	45	48	67	50
50.01-150.00	50	53	67	55
150.01-300.00	55	58	67	57
300.01-500.00	60	63	67	59
500.01-700.00	62	65	67	61
700.00-1000.00	64	67	67	63

G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

H. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

I. Coil Conductors: Continuous windings with terminations brazed or welded.

J. Enclosure: NEMA ST 20; Type 1. Provide lifting eyes or brackets.

K. Isolate core and coil from enclosure using vibration-absorbing mounts.

L. Nameplate: NEMA TP 3; Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 HARMONIC MITIGATING TRANSFORMERS

A. Dry Type Harmonic Mitigating Transformers: ANSI/NEMA ST 20; factory-assembled, air-cooled dry, copper wound, type 200% rated neutral transformers; ratings as shown on the drawings. Transformers supplied under this project shall meet the US Department of Energy (DOE) 2016 Efficiency requirements or the most current DOE CFR in effect.

B. Insulation system and average winding temperatures rise for rated KVA as follows:

KVA Rating	Insulation Class	Temperature Rise (degree C)
1-9	185	115
10-500	220	130

C. Case temperature shall not exceed 40°C rise above ambient at its warmest point.

D. Winding Taps, Transformers: Two (2) 2-1/2 percent below and two (2) 2-1/2 percent above rated voltage, full capacity taps on primary winding.

E. Sound Levels: Average audible sound level shall not exceed the values given below when tested to NEMA ST 20 standards:

Equivalent Winding kVA Range	Average Sound Level, Decibels			
	Self-Cooled Ventilated			Self-Cooled Sealed
	K-Factor = 1 K-Factor = 4 K-Factor = 9	K-Factor = 13 K-Factor = 20	Forced Air w/ Fans Running	
0-9	40	40	67	45
9.01-30.00	45	45	67	50
30.01-50.00	45	48	67	50
50.01-150.00	50	53	67	55
150.01-300.00	55	58	67	57
300.01-500.00	60	63	67	59
500.01-700.00	62	65	67	61
700.00-1000.00	64	67	67	63

F. Provide +/- 15% phase on the primary windings (total 30% phase shift) of harmonic mitigating transformers wired in parallel from the same distribution source.

G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

H. Provide electrostatic winding shield with separate insulated grounding connection.

I. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor or trapeze mounting.

J. Coil Conductors: Continuous windings with terminations brazed or welded.

K. Enclosure: NEMA ST 20; Type 1. Provide lifting eyes or brackets.

L. Isolate core and coil from enclosure using vibration-absorbing mounts.

M. Nameplate: NEMA TP 3; Include transformer connection data.

2.3 ACCESSORIES

A. Electronic Isolation Shield:

1. Provide electrostatic winding shield with separate insulated grounding connection as shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on four 3"x3"x1/2" thick, 50 durometer rubber vibration isolating pads suitable for isolating the transformer noise from the building structure.

3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments. Adjustments shall be made at completion of project and at approximately 6 months following project acceptance when requested by the Owner.

END OF SECTION 26 22 00

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service and distribution panelboards: [DP-#], [DP-#]
- B. Lighting and appliance branch circuit panelboards: [Panel '###']
- C. Fusible branch circuit panelboards: [Panel '###']
- D. Load centers: [Panel '###']

1.2 RELATED SECTIONS AND WORK

- A. Refer to the One-Line Diagram and Panel Schedules for size, rating, and configuration.

1.3 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers
- B. NEMA FU 1 – Low voltage cartridge fuses
- C. NEMA KS 1 - Enclosed Switches
- D. NEMA PB 1 - Panelboards
- E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment
- G. UL 248 – Low-Voltage Fuses
- H. UL 67 - Panelboards

1.4 SUBMITTALS

- A. Submit shop drawings for equipment and component devices under provisions of Section 26 05 00.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Selective coordination study to prove that all essential electrical systems, emergency systems and legally required standby system panelboards are selectively coordinated with all supply side overcurrent protective devices.

1.5 SPARE PARTS

- A. Keys: Furnish four (4) each to the Owner.
- B. Fuses: Furnish 10% or a minimum of three (3) spare fuses of each type and rating installed to the Owner.
- C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

A. Definitions:

1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 26 05 53 for additional requirements.
2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

- B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

A. General

1. Approved Manufacturers:

- a. Square D QMB, I-Line
- b. General Electric Spectra ADS
- c. Siemens F2, P4

- B. Panelboards: NEMA PB 1; type as shown on the drawings.

- C. Enclosure: NEMA PB 1; Type 1.

- D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Finish in manufacturer's standard gray enamel.

- E. Provide panelboards with aluminum bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

- F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.

- G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240 volt panelboards; 50,000 amperes rms symmetrical for 480 volt panelboards, or as shown on the drawings.

- H. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

- I. Fuse Clips (Switches 600 Amperes and Smaller): Provide with Class 'R' rejection clips. Fuse Clips (601 Amperes and Larger): Designed to accommodate Class 'L' fuses.

- J. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

- K. Molded Case Circuit Breakers with Current Limiters: Provide circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

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- L. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
 - M. Solid State Molded Case Circuit Breakers: **(All breakers identified on plans as solid-state with 1,200 ampere frame sizes and below.)** Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a sealable clear cover.
 - N. Suitable for use as service entrance equipment.
 - O. [DPM]: Digital AC Power Monitor mounted in face of distribution panel. Capable of measuring, calculating and directly displaying; Volts (L-L, L-N), Amps, KW, KWH. Monitor shall be true RMS measurement with programmable set-up parameters. All set-up parameters data shall be stored in non-volatile memory to protect from power outages. Provide BACnet interface to FMCS.

2.3 BRANCH CIRCUIT PANELBOARDS

- A. General
 - 1. Approved Manufacturers:
 - a. Square D NQ, NF
 - b. General Electric AQ, AE
 - c. Siemens P1
- B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- C. Enclosure: NEMA PB 1; Type 1.
- D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with aluminum bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.
- G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.
- H. Minimum Integrated Short Circuit Rating: As shown on the drawings.
- I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.
- J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.
- K. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS

A. General

1. Approved Manufacturers:
 - a. Bussmann
 - b. Littelfuse
 - c. Mersen MFCP
- B. Provide cabinet front with concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- C. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- D. Overcurrent protective devices shall be UL listed, with voltage, amperage, number of poles, and short-circuit current rating as shown on the panelboard schedule. Multi-pole branch circuit protection devices shall trip on an overcurrent of any pole to prevent single-phasing of the load.
- E. Fuse holder shall be finger-safe with trim installed. Fuses shall only be removable when terminals are not energized.
- F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future fuse units.
- G. All multiple-section panelboards shall have the same dimensional backbox and cabinet front size.
- H. Minimum Integrated Short Circuit Rating: As shown on the drawings.
- I. Branch fuse disconnect shall have visible ON/OFF indication, blown fuse indicating lights, and permanently installed lockout means.

2.5 LOAD CENTERS

A. General

1. Approved Manufacturers:
 - a. Square D
 - b. General Electric
 - c. Siemens
- B. Load Centers: Circuit breaker load center.
- C. Enclosure: General-Purpose.
- D. Provide lock on door. Finish in manufacturer's standard gray enamel.
- E. Provide load centers with bus ratings as shown on the drawings.
- F. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical.
- G. Molded Case Circuit Breakers: Provide plug-on circuit breakers with integral thermal and instantaneous magnetic trip in each pole, with common trip handle for all poles. Provide breaker interrupting ratings as indicated on the plans. Where necessary to meet interrupting ratings, breakers shall be provided with automatically resetting current limiting elements in each pole. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings.

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- H. Do not use tandem circuit breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.
- B. Height: 6 feet to handle of highest device.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide typed circuit directory for each branch circuit panelboard. Label each circuit with the type of load and the name and number of the area served. Revise directory to reflect circuit changes required to balance phase loads.
- E. Stub five (5) empty one inch conduits to accessible location above ceiling out of each recessed panelboard.
- F. Install fuses in fusible switch assemblies.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION 26 24 16

SECTION 26 24 19 - MOTOR CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual motor starters
- B. Magnetic motor starters
- C. Combination magnetic motor starters
- D. Solid-state reduced voltage motor starters (soft starters)
- E. Motor control centers
- F. Motor starter panelboards

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Disconnect and Starter Schedule and One-Line Diagram for rating and configuration.

1.3 REFERENCES

- A. ANSI/UL Standard 508. Standard for Industrial Control Equipment
- B. FCC Rules and Regulations, Part 15, Subpart J- Radio Frequency Interference
- C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service
- D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)
- E. FS W-P-115 - Power Distribution Panel
- F. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted
- G. IEEE Standard 519-1981 - Guide for Harmonic Control and Reactive Compensation of Static Power Converters
- H. NEMA AB 1 - Molded Case Circuit Breakers
- I. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- J. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- K. NEMA KS 1 - Enclosed Switches
- L. NEMA PB 1 - Panelboards
- M. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or less

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Indicate on shop drawings, front and side views of motor control center enclosures with overall dimensions. Include conduit entrance locations and requirements; wiring diagrams that differentiate between manufacturer-installed and field-installed wiring; nameplate legends; size and number of bus bars per phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.

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- C. Provide product data on motor starters and combination motor starters, relays, pilot devices, and switching and over-current protective devices.
 - D. Submit manufacturer's instructions under provisions of Section 26 05 00.

1.5 SPARE PARTS

- A. Keys: Furnish four (4) each to the Owner.
- B. Fuses: Furnish three (3) spare fuses of each type and rating installed to the Owner.
- C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Deliver in 60 inch maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids.
- C. Store and protect products under provisions of Section 26 05 00.
- D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from fumes, dirt, water, construction debris, traffic, and physical damage.
- E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 MANUAL MOTOR STARTERS

- A. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing full-voltage controller for induction motors rated in horsepower, with overload relay, and toggle operator.
- B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator.
- C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, and toggle operator.
- D. Enclosure: NEMA ICS 6; Type 1.

2.2 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Full Voltage Starting: Non-reversing type, unless otherwise indicated.

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- C. Coil Operating Voltage: 120 volts, 60 Hertz, obtained from integral control power transformer of sufficient capacity to operate connected pilot, indicating, and control devices, plus 100% spare capacity.
 - D. Size: NEMA ICS 2; size as shown on the drawings.
 - E. Overload Relay:
 - 1. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.
 - F. Enclosure: NEMA ICS 6; Type 1.
 - G. Combination Motor Starters: Combine motor starters with disconnect switch in common enclosure. Provide with disconnecting means as indicated on drawings.
 - H. Auxiliary Contacts: NEMA ICS 2; two normally open, field convertible contacts in addition to seal-in contact.
 - I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.
 - J. Indicating Lights: NEMA ICS 2; RUN: red in front cover.
 - K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.
 - L. Relays: NEMA ICS 2.
 - M. Control Power Transformers: 120 volt fused secondary, fused primary, minimum VA as scheduled:
 - Size 1 - 100 VA
 - Size 2 - 100 VA
 - Size 3 - 150 VA
 - Size 4 - 300 VA
 - Size 5 - 300 VA
 - Size 6 - 300 VA
 - N. Provide phase loss protection relay with contacts to de-energize the starter for each starter serving motors 5 HP or greater.

2.3 SOLID-STATE REDUCED VOLTAGE MOTOR STARTERS (SOFT STARTERS)

- A. Soft Starters: ANSI/UL Standard 508. Used with NEMA Design B, AC induction motors to reduce in-rush current and mechanical shocks associated with starting and stopping motors.
- B. Operation: The soft starter shall utilize a thyristor (SCR) bridge to control the starting and stopping of the motor. A microprocessor shall monitor the current and control the phasing of the SCRs. The soft starter shall provide torque control for linear acceleration without external feedback independent of motor load or motor application.
- C. Torque ramp: Adjustable (by keypad) from 1 to 60 seconds.
- D. Shorting Contactor: A shorting contactor shall be supplied with all soft starters rated above 40 amps. The shorting contactor shall close after the current is below 130% of motor full-load amps at the nominal voltage. The shorting contactor shall open on a stop command to allow a deceleration ramp, if applicable.
- E. Status & Diagnostics: Door-mounted keypad for display of soft starter, motor, and fault statuses.

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- F. Motor Protection against Solid-State Component Failure: Provide an isolation contactor that opens when the motor is stopped or when the controller detects a fault condition such as a shorted thyristor.
 - G. Over-Current Protection Device / Power Disconnect: Integral molded case disconnect switch and in-line fuse block for RK type power fuses (up to 600 amps). Short circuit current rating shall be 65,000 AIC minimum or as indicated on drawings.
 - H. Overcurrent Condition: The soft starter shall be capable of supplying 300% of rated full load current for 30 seconds at maximum ambient temperature.
 - I. Electronic Protective Features: Thermal overload protection, phase reversal protection, stall protection, locked rotor protection, and underload protection. The display shall also indicate a starter thermal fault, phase fault, frequency fault, external fault, maximum start time exceeded, serial link fault, and internal failure.
 - J. Controls: The control circuitry shall be fed internally from the line supply, completely independent of the power circuit and separate from the control logic. The control circuitry shall operate at 120 VAC via an integral control power transformer.
 - K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.
 - L. Input: Remote control start/stop signal, and one logic input for force to freewheel, indication of external fault, force to local control, or remote overload reset.
 - M. Outputs: Isolation contactor status, torque ramp status, overload pre-alarm, fault alarms, and one field convertible auxiliary contact. One analog output shall be available for 4-20mA indication of motor current, torque, thermal state, or power factor.
 - N. Current and Horsepower Ratings: As indicated in the Starter/Disconnect Schedule on the drawings.
 - O. Input/Output Voltage: As indicated in the Starter/Disconnect Schedule on the drawings. The controller shall be capable of operating between -15% to +10% of nominal voltage rating.
 - P. Environmental Characteristics: Ambient Air Temperature: 0°C to 40°C; Maximum Relative Humidity: 93% (non-condensing); Minimum Elevation without Derating: 3300 feet.
 - Q. Enclosure: NEMA ICS 6; Type 12, with provisions for padlocking the door.

2.4 CONTROLLER OVER-CURRENT PROTECTION AND DISCONNECTING MEANS

- A. Molded Case Thermal-Magnetic Circuit Breakers: Circuit breakers with integral thermal and instantaneous magnetic trip in each pole. NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
- B. Non-fusible Switch Assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Provide with Class 'R' rejection clips. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing laboratory.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions on concrete bases.
- B. Motor Starter Panelboard Installation: In conformance with NEMA PB 1.1.
- C. Install fuses in fusible switches.
- D. Select and install heater elements in motor starters to match installed motor characteristics.
- E. Set field-adjustable switches and circuit-breaker trip ranges.
- F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.
- G. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

END OF SECTION 26 24 19

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Device plates and box covers
- B. Modular connectors
- C. Receptacles including GFCI tamper resistant and/or weather resistant
- D. Pin and sleeve devices
- E. Wall switches
- F. Wall dimmers
- G. Local daylighting controls
- H. Floor boxes
- I. Service fitting
- J. Pedestal style box
- K. Poke-through fittings
- L. Indoor occupancy and vacancy sensors
- M. Pendant cord/connector devices
- N. Cord and plug sets
- O. Cord reel

1.2 QUALITY ASSURANCE

- A. Provide similar devices from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NEC Article 100, by a testing agency to Authorities Having Jurisdiction and marked for intended use.
- C. Comply with the NEC.

1.3 REFERENCES

- A. DSCC W-C-896F – General Specification for Electrical Power Connector
- B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- C. FS W-S-896 - Switch, Toggle
- D. NEMA WD 1 – General Color Requirements for Wiring Devices
- E. NEMA WD 6 – Wiring Devices – Dimensional Requirements
- F. NFPA 70 - National Electrical Code (NEC)
- G. UL 498 – Standard for Attachment Plugs and Receptacles
- H. UL 943 – Standard for Ground Fault Circuit Interrupters
- I. UL 1472 – Solid-State Dimming Controls

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.

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- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.
 - C. Submit manufacturer occupancy sensor coverage patterns applicable to this project. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form.

1.5 COORDINATION

- A. Receptacles for Owner Furnished Equipment: Match plug configurations.
- B. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

- A. All switch, receptacle, outlet, and coverplate colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

- A. All switches, receptacles, and outlets shall be complete with the following:
 - 1. Unbreakable thermoplastic/thermoset plastic coverplates in finished spaces where wall are finished.
 - 2. #302 stainless steel coverplates in unfinished spaces for flush boxes.
 - 3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 26 05 53.
- D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 RECEPTACLES

- A. Refer to Electrical Symbols List for device type.
- B. Devices that are shaded on the drawings shall be red.
- C. **[REC-DUP]:** NEMA 5-20R Duplex Receptacle:
 - 1. 125 volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.
 - 2. Approved Manufacturers: Hubbell 5362, Leviton 5362, Pass & Seymour 5362A, Cooper AH5362.
- D. **[REC-DUP-GFI]:** NEMA 5-20R Ground Fault Duplex Receptacle:
 - 1. 125 volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face.
 - 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.

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3. Approved Manufacturers: Hubbell GF20L, Leviton GFNT2, Pass & Seymour 2097, Cooper SGF20.
- E. **[REC-DUP-GFI-R]:** Remote Ground Fault Device:
1. Ground fault device for remote downstream receptacles. 125 volt, 20 amp. Test and reset buttons in impact resistance thermoplastic face.
 2. Approved Manufacturers: Hubbell GFBF20, Leviton 6895, Pass & Seymour 2085, Cooper VGFD20.
- F. **[REC-DUP-WP]:** NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.
 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
 3. Approved Manufacturers: Hubbell GFTR20/(RW57300) WP826, Leviton GFWT2/(5977-CL) M5979, Pass & Seymour 2097TRWR/(WIUC10-C) WIUCAST1, Cooper WRS GF20/(WIU-1) WIUMV-1.
- G. **[REC-DUP-XP]:** NEMA 5-20R Explosion Proof Duplex Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type, Class 1, Division 1 rated. Spring-loaded cover with gasket. Mount in cast box with threaded openings.
 2. Approved Manufacturers: Appleton EFSC175, Crouse-Hinds ENRC21201, Killark UGR5-20231.
- H. **[REC-USB]:** NEMA 5-20R Receptacle with USB Charger:
1. 125 volt, 20 amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. USB charging rated at 5VDC 2.1A. Mounted in double gang backbox.
 2. Approved Manufacturers: Hubbell USB20X2, Pass & Seymour TR5362USB, Cooper TR7766.
- I. **[REC-SIM-520R]:** NEMA 5-20R Simplex Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL5361, Leviton, 5361, Pass & Seymour 5361, Cooper 5361.
- J. **[REC-SIM-530R]:** NEMA 5-30R Simplex Receptacle:
1. 125 volt, 30 amp, 3-wire grounding type, phenolic face.
 2. Approved Manufacturers: Hubbell HBL9308, Leviton 5371, Pass & Seymour 3802, Cooper 5716N.
- K. **[REC-SIM-550R]:** NEMA 5-50R Simplex Receptacle:
1. 125 volt, 50 amp, 3-wire grounding type, phenolic face.
 2. Approved Manufacturers: Hubbell HBL9360, Cooper 1253.
- L. **[REC-SIM-620R]:** NEMA 6-20R Simplex Receptacle:
1. 250 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL5461, Leviton 5461, Pass & Seymour 5871, Cooper 5461.

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- M. **[REC-SIM-630R]:** NEMA 6-30R Simplex Receptacle:
1. 250 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL9330, Leviton 5372, Pass & Seymour 3801, Cooper 5700N.
- N. **[REC-SIM-650R]:** NEMA 6-50R Simplex Receptacle:
1. 250 volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL9367, Leviton 5374, Pass & Seymour 3804, Cooper 5709N.
- O. **[REC-SIM-720R]:** NEMA 7-20R Simplex Receptacle:
1. 277 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour 7621,.
- P. **[REC-SIM-730R]:** NEMA 7-30R Simplex Receptacle:
1. 277 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL9315, Leviton 9730-A, Pass & Seymour, Cooper 5795N.
- Q. **[REC-SIM-750R]:** NEMA 7-50R Simplex Receptacle:
1. 277 volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL9365, Leviton 9750-A, Pass & Seymour, Cooper.
- R. **[REC-SIM-1420R]:** NEMA 14-20R Simplex Receptacle:
1. 125/250 volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL8410, Pass & Seymour 3820, Cooper 5759.
- S. **[REC-SIM-1430R]:** NEMA 14-30R Simplex Receptacle:
1. 125/250 volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +24 AFF.
 2. Approved Manufacturers: Hubbell HBL9430A, Leviton 278, Pass & Seymour 3864, Cooper 5744N.
- T. **[REC-SIM-1450R]:** NEMA 14-50R Simplex Receptacle:
1. 125/250 volt, 50 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +4" AFF.
 2. Approved Manufacturers: Hubbell HBL9450A, Leviton 279, Pass & Seymour 3894, Cooper 5754N.
- U. **[REC-SIM-1460R]:** NEMA 14-60R Simplex Receptacle:
1. 125/250 volt, 60 amp, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL9460A, Leviton 9460, Pass & Seymour, Cooper 9460N.

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- V. **[REC-SIM-1520R]:** NEMA 15-20R Simplex Receptacle:
1. 250 volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL8420, Leviton, Pass & Seymour, Cooper.
- W. **[REC-SIM-1530R]:** NEMA 15-30R Simplex Receptacle:
1. 250 volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL8430A, Leviton 8430, Pass & Seymour 5740, Cooper 8430N.
- X. **[REC-SIM-1550R]:** NEMA 15-50R Simplex Receptacle:
1. 250 volt, 50 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL8450A, Leviton 8450, Pass & Seymour 5750, Cooper 8450N.
- Y. **[REC-SIM-1560R]:** NEMA 15-60R Simplex Receptacle:
1. 250 volt, 60 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL9460A, Pass & Seymour 5760, Cooper 8460N.
- Z. **[REC-SIM-L520R]:** NEMA L5-20R Simplex Receptacle, Locking Type:
1. 125 volt, 20 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.
 2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L520, Cooper CWL520R.
- AA. **[REC-SIM-L530R]:** NEMA L5-30R Simplex Receptacle Locking Type:
1. 125 volt, 30 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.
 2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L530, Cooper CWL530R.
- BB. **[REC-SIM-L620R]:** NEMA L6-20R Locking Type Simplex Receptacle:
1. 250 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2320, Leviton 2320, Pass & Seymour L620R, Cooper CWL620R.
- CC. **[REC-SIM-L630R]:** NEMA L6-30R Locking Type Simplex Receptacle:
1. 250 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2620, Leviton 2620, Pass & Seymour L630R, Cooper CWL630R.
- DD. **[REC-SIM-L720R]:** NEMA L7-20R Locking Type Simplex Receptacle:
1. 277 volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2330, Leviton 2330, Pass & Seymour L720R, Cooper CWL720R.

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- EE. **[REC-SIM-L730R]:** NEMA L7-30R Locking Type Simplex Receptacle:
1. 277 volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2630, Leviton 2630, Pass & Seymour L730R, Cooper CWL730R.
- FF. **[REC-SIM-L1420R]:** NEMA L14-20R Locking Type Simplex Receptacle:
1. 125/250 volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL 2410, Pass & Seymour L1420, Cooper CWL1420R.
- GG. **[REC-SIM-L1430R]:** NEMA L14-30R Locking Type Simplex Receptacle:
1. 125/250 volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL 2710, Leviton 2710, Pass & Seymour L1430R, Cooper CWL1430R.
- HH. **[REC-SIM-L1520R]:** NEMA L15-20R Locking Type Simplex Receptacle:
1. 250 volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2420, Leviton 2420, Pass & Seymour L1520R, Cooper CWL1520R.
- II. **[REC-SIM-L1530R]:** NEMA L15-30R Locking Type Simplex Receptacle:
1. 250 volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2720, Leviton 2720, Pass & Seymour L1530R, Cooper CWL1530R.
- JJ. **[REC-SIM-L1620R]:** NEMA L16-20R Locking Type Simplex Receptacle:
1. 480 volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2431, Pass & Seymour L1620R, Cooper CWL1620R.
- KK. **[REC-SIM-L1630R]:** NEMA L16-30R Locking Type Simplex Receptacle:
1. 480 volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.
 2. Approved Manufacturers: Hubbell HBL2730, Leviton 2730, Pass & Seymour L1630R, Cooper CWL1630R.
- LL. **[REC-SIM-L2120R]:** NEMA L21-20R Locking Type Simplex Receptacle:
1. 120/208Y 3 phase 20 amp 5 wire grounding type.
 2. Approved Manufacturers: Hubbell HBL2510, Cooper CWL2120R, Pass & Seymour L2120R.
- MM. **[REC-SIM-L2130R]:** NEMA L21-30R Locking Type Simplex Receptacle:
1. 120/208Y 3 phase 30 amp 5 wire grounding type.

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2. Approved Manufacturers: Hubbell HBL2750, Cooper CWL2130R, Pass & Seymour L2130R.
- NN. **[REC-SIM-XP]:** NEMA 5-20R Explosion Proof Simplex Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type, Class 1, Division 1, Group C rated. Factory sealed, dead end.
 2. Approved Manufacturers: Appleton CPE1-2375, Crouse-Hinds CPS152201, Killark KRS-215-220.
- OO. **[REC-TAMP]:** NEMA 5-20R Tamper Resistant Duplex Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.
 2. Approved Manufacturers: Hubbell BR20TR, Leviton TBR20, Pass & Seymour TR5362, Cooper TRBR20.
- PP. **[REC-TAMP-GFI]:** NEMA 5-20R GFI Tamper Resistant Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type tamper-resistant with test and reset buttons in impact resistant thermoplastic face.
 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
 3. Approved Manufacturers: Hubbell GFTR20, Cooper TRSGF20, Pass & Seymour 2097TR, Leviton GFTR2.
- QQ. **[REC-TAMP-QUAD]:** NEMA 5-20R Double Duplex Tamper Resistant Receptacle:
1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.
 2. Approved Manufacturers: Refer to Tamper Resistant Receptacle above.
- RR. **[REC-DUP-O]:** NEMA 5-20R Plug Load Controlled Duplex Receptacle:
1. 125 volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap. Bottom half of duplex shall be split circuit wired and controlled by remote relay. Controlled receptacle shall have permanent NEMA approved and NEC 2014 compliant marking on face of device.
 2. Approved Manufacturers: Pass & Seymour 5362H, Leviton 5362-1P, Hubbell, Cooper.
- SS. **[REC-QUAD]:** NEMA 5-20R Double Duplex Receptacle:
1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.
 2. Approved manufacturers: Refer to Duplex Receptacle above.
- TT. **[REC-QUAD-GFI]:** NEMA 5-20R Double Duplex GFI Receptacle:
1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.
 2. Approved Manufacturers: Refer to Duplex GFI Receptacle above.
- UU. **[REC-QUAD-USB]:** NEMA 5-20R Double Duplex USB Receptacle:
1. Consists of two duplex USB receptacles, double gang box, plaster ring and faceplate.
 2. Approved Manufacturers: Refer to USB Receptacle above.

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- VV. **[REC-QUAD-WP]:** NEMA 5-20R Weatherproof Ground Fault Quad Receptacle:
1. Consists of two duplex, GFI receptacles. Double gang box. Provide NEMA 3R rated while-in-use cast aluminum cover.
 2. Approved Manufacturers:
 - a. Receptacle: Refer to GFCI Receptacle above.
 - b. Cover: Intermatic WP1030MXD, Pass & Seymour WIUCAST2, Thomas & Betts Red Dot 2CKU.
- WW. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for connection to #12 or #10 copper conductors.
- XX. Side wired devices shall have four binding screws that are undercut for positive wire retention.
- YY. Ground Fault Circuit Interrupter (GFCI) receptacles shall comply with the 2006 edition of U.L. 943 requiring increased surge immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for miswiring if the line and load conductors are reversed during installation.
- ZZ. Hazardous (Classified) location receptacles shall comply with NEMA FB 11.

2.4 WALL SWITCHES

- A. Refer to Electrical Symbols List for device type.
- B. **[SW-1P]:** Single Pole Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired.
 2. Approved Manufacturers: Hubbell HBL1221, Leviton 1221-2, Pass & Seymour PS20AC1, Cooper AH1221.
- C. **[SW-1P-060]:** Spring Wound Local Timer Switch:
1. 125 volt, 20 amp rated. 0 to 60 minute off delay.
 2. Approved Manufacturers: Paragon SWPD60M, Tork A560M, Mark-Time 9008.
- D. **[SW-1P-ADJ]:** Local Timer Switch:
1. User adjustable timeout, 120/277 volt, 800/1200 watt rating. No minimum load requirement. Flashes lights one minute before timeout.
 2. Approved Manufacturers: Watt Stopper TS-400, Hubbell Automation TD200.
- E. **[SW-1P-EM]:** Emergency Single Pole Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Red toggle handle, side and back wired. Switch shall have with illuminated handle that is illuminated when load is off.
 2. Approved Manufacturers: HBL1221R, Leviton 1221-2R, Pass & Seymour PS20AC1-RED, Cooper AH1221RD.

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- F. **[SW-1P-EX]:** Explosion Proof Single Pole Switch:
1. 120/277 volt, 20 amp maintained contact. Toggle handle. Suitable for use in Class 1, Division 1 areas.
 2. Approved Manufacturers: Appleton EDSC175-F2, Crouse Hinds, Killark.
- G. **[SW-1P-K]:** Key Lock Single Pole Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.
 2. Approved Manufacturers: Hubbell HBL1221L, Leviton 1221-2L, Pass & Seymour PS20AC1-L.
- H. **[SW-1P-LH]:** Lighted Handle Single Pole Switch:
1. 120 volt maintained contact. Toggle handle. Light on when contact open (switch off). Side and back wired.
 2. Approved Manufacturers: Hubbell HBL1221ILC, Leviton 1221-LHC, Pass & Seymour PS20AC1-CSL, Cooper 2221LTW.
- I. **[SW-1P-M]:** Momentary Contact Single Pole Switch:
1. 120/277 volt, 20 amp. Three position, two circuit. Center off toggle spring return handle.
 2. Approved Manufacturers: Hubbell HBL1557, Leviton 1257, Pass & Seymour 1251, Cooper 1995.
- J. **[SW-1P-PL]:** Red Pilot Light Single Pole Switch:
1. 120 volt maintained contact. Toggle handle. Pilot light on when contact closed (switch on). Side and back wired.
 2. Approved Manufacturers: Hubbell HBL1221PL, Leviton 1221-PLR, Pass & Seymour PS20AC1-RPL, Cooper AH1221PL.
- K. **[SW-1P-WP]:** Weatherproof Single Pole Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired. Provide with weatherproof coverplate.
 2. Approved Manufacturers: Hubbell1221/HBL1795, Leviton 1221-2, Taymac MM180, Pass & Seymour PS20AC1/CA1-GL, Cooper 2221.
- L. **[SW-2P]:** Two Pole Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Toggle handle, side and back wired.
 2. Approved Manufacturers: Hubbell HBL 1222, Leviton 1222-2, Pass & Seymour PS20AC2, Cooper 2222.
- M. **[SW-2P-K]:** Key Lock Two Pole Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.
 2. Approved Manufacturers: Hubbell HBL1222L, Leviton 1222-2L, Pass & Seymour PS20AC2-L.

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- N. **[SW-3W]:** Three-way Switch:
1. 120/277 volt, 20 amp. Toggle handle, side and back wired.
 2. Approved Manufacturers: Hubbell 1223, Leviton 1223-2, Pass & Seymour PS20AC3, Cooper AH1223.
- O. **[SW-3W-EM]:** Emergency Three-way Switch:
1. 120/277 volt, 20 amp. Red toggle handle, side and back wired.
 2. Approved Manufacturers: Hubbell 1223R, Leviton 1223-2R, Pass & Seymour PS20AC3-RED, Cooper AH1223RD.
- P. **[SW-3W-K]:** Key Lock Three Way Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.
 2. Approved Manufacturers: Hubbell HBL1223L, Leviton 1223-2L, Pass & Seymour PS20AC3-L.
- Q. **[SW-4W]:** Four-way Switch:
1. 120/277 volt, 20 amp. Toggle handle, side and back wired.
 2. Approved Manufacturers: Hubbell 1224, Leviton 1224-2, Pass & Seymour PS20AC4, Cooper AH1224.
- R. **[SW-4W-EM]:** Emergency Four-way Switch:
1. 120/277 volt, 20 amp. Red toggle handle, side and back wired.
 2. Approved Manufacturers: Hubbell HBL1224R, Leviton 1224-2R, Pass & Seymour PS20AC4-RED, Cooper AH1224RD.
- S. **[SW-4W-K]:** Key Lock Four Way Switch:
1. Single throw, 120/277 volt, 20 amp maintained contact. Side and back wired. Provide key to Owner.
 2. Approved Manufacturers: Hubbell HBL1224L, Leviton 1224-2L, Pass & Seymour PS20AC4-L.
- T. **[SW-COMB]:** Combination Single Pole Switch and GFCI Receptacle:
1. Single throw switch, 120 volt, 15 amp maintained contact. Toggle handle, side and back wired. NEMA 5-15R GFCI receptacle with test and reset buttons.
 2. Approved Manufacturers: Hubbell GFSP15, Leviton 7229, Pass & Seymour 1595-SWTTR, Cooper VGFS15.

2.5 WALL DIMMERS

- A. UL listed with integral air-gap switch for on/off control.
- B. Integral EMI/RFI suppression.
- C. Non-viewable heat sink.

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- D. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.
- E. Dimmer to match device color.
- F. **[SW-D-6]:** 600 Watt Single Pole Incandescent Dimmer:
1. 120 volt, linear slider operator with positive off. Mount in single gang box.
 2. Approved Manufacturers: Hunt Dimming.
- G. **[SW-D-10]:** 1000 Watt Single Pole Incandescent Dimmer:
1. 120 volt, linear slider operator with positive off. Mount in single gang box.
 2. Approved Manufacturers: Hunt Dimming.
- H. **[SW-D-15]:** 1500 Watt Single Pole Incandescent Dimmer
1. 120 volt, linear slider operator with positive off. Mount in double gang box.
 2. Approved Manufacturers: Hunt Dimming.
- I. **[SW-D-20]:** 2000 Watt Single Pole Incandescent Dimmer:
1. 120 volt, linear slider operator with positive off. Mount in double gang box.
 2. Approved Manufacturers: Hunt Dimming.
- J. **[SW-D-LED]:** LED Electronic Driver Dimmer:
1. Decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60629 Annex E.
 2. Approved Manufacturers: Hunt Dimming. Compatible with provided LED driver.
- K. **[SW-D3-6]:** 600 Watt Three-Way Incandescent Dimmer:
1. 120 volt, linear slider operator with positive off. Mount in single gang box.
 2. Approved Manufacturers: Hunt Dimming.
- L. **[SW-D3-10]:** 1000 Watt Three-Way Incandescent Dimmer:
1. 120 volt, linear slider operator with positive off. Mount in single gang box.
 2. Approved Manufacturers: Hunt Dimming.
- M. **[SW-D3-15]:** 1500 Watt Three-Way Incandescent Dimmer:
1. 120 volt, linear slider operator with positive off. Mount in double gang box.
 2. Approved Manufacturers: Hunt Dimming.

N. **[SW-D3-20]:** 2000 Watt Three-Way Incandescent Dimmer:

1. 120 volt, linear slider operator with positive off. Mount in double gang box.
2. Approved Manufacturers: Hunt Dimming.

O. **[SW-D3-LED]:** LED Electronic Driver Three-Way Dimmer:

1. Decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply with IEC 60929 Annex E.
2. Approved Manufacturers: Hunt Dimming. Compatible with provided LED driver.

2.6 LOCAL DAYLIGHTING CONTROLS

A. All daylighting controls shall be line voltage type.

B. Standalone Interior Photo Sensors:

1. **[SW-LS]:** Daylight Level Sensor - On/Off Control - One Zone:

- a. On/Off control. Range of 10-200 FC. Adjustable deadband prevents cycling. Adjustable time delay.
- b. Approved Manufacturers: Watt Stopper LS-102, Sensor Switch CM-PC, Hubbell Automation DLCPC Series, Greengate PPS-4.

2. **[SW-LS-3Z]:** Daylight Level Sensor and Controller - On/Off Control - Three Zones:

- a. On/off control of up to three 10-amp zones. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay.
- b. Approved Manufacturers: Watt Stopper LCO-203/LS-290C, Hubbell Automation LUXSTATOCM/LUXSTATLS, LC&D Micro GR/2404 IDH/Pcell, Sensor Switch N-CMPC.

3. **[SW-LS-D]:** Daylight Level Sensor and Controller - 0-10V Dimming - One Zone:

- a. Dimming control of one 0-10V zone. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay. Coordinated with dimming ballast prior to submittal.
- b. Approved Manufacturers: Watt Stopper LS-301, Hubble Automation DLC7, Sensor Switch N-CMADC.

4. **[SW-LS-D-3Z]:** Daylight Level Sensor and Controller - Dimming - Three Zones:

- a. Dimming control of up to three zones of 0-10V. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay. Coordinate with dimming ballasts prior to submittal.
- b. Approved Manufacturers: Watt Stopper LCD-203/LS-290C, Hubbell Automation LUXSTATDCM/LUXSTATLS, LC&D Micro GR/2404 IDIM/Pcell, Sensor Switch N-CMADC.

5. **[SW-LS-M]:** Daylight Level Sensor and Controller - Multilevel/Bi-level On/Off Control - Dual Zones:

- a. Multilevel/bi-level on/off control of up to two 10-amp zones. Range of 10 to 200 FC. Adjustable deadband prevents cycling. Adjustable time delay.

b. Approved Manufacturers: Watt Stopper LCO-203/LS-290C, Hubbell Automation DLCPCPC/DLCPCI, Sensor Switch CM-PC-DZ.

6. Sensor shall detect changes in ambient light level and provide triggering of lighting groups in area based on sequence of operation.
7. Sensor shall be configurable via DIP switches at device or via handheld wireless remote programming unit. Settings shall include:
 - a. Ambient sensitivity range between 1 and 1,000 foot-candles.
 - b. Time delay of 5 to 300 seconds.
 - c. Trigger setpoints with deadband adjustment.
8. Sensor shall provide on/off setpoints in quantity as specified on drawings, and as shown in the sequence of operation.
9. Sensor shall be ceiling- or wall-mounted for range and viewing angle meeting application requirements as outlined in the sequence of operation.
10. Output signal from sensor shall be linear with light level.

C. **[SW-LS-PC]:** Standalone Exterior Photo Sensors:

1. Sensor shall be within a weatherproof enclosure, with design operation in temperatures of -30°F to +130°F. Sensor shall have threaded stem for box mounting, with knuckle to permit aiming of receptor after installation. Sensor shall be mounted facing north.
2. Sensor shall contain an integral switching contactor rated for 277 volt operation, with loads of up to 1,800 VA. Contacts shall be configured for zero-crossing closure to provide 100,000 cycle minimum operation.
3. Sensor shall detect changes in daylight levels to provide triggering of exterior lighting equipment based on the sequence of operation.
4. Sensor shall be field configurable at the device or via handheld wireless remote controller. Configurable settings shall include:
 - a. Ambient sensitivity range of 5 to 1,500 foot-candles.
 - b. Adjustable setpoint.
 - c. Deadband adjustment by percentage of setpoint.
 - d. Time delay of up to five minutes.
5. Sensor shall be equipped with a lens cover that can be applied for system testing during daylight conditions.
6. Approved Manufacturers: Paragon, Tork, Intermatic.

2.7 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.

1. All occupancy sensors shall be line voltage type.
2. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time delay for turning lights off when unoccupied.

-
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 4. Relay Unit: Dry contacts rated for 20 A ballast load at 120 and 277 VAC, for 13 amp tungsten at 120 VAC, and for 1 hp at 120 VAC. Power supply to sensor shall be 24 V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.
 - c. Time Delay and Sensitivity Adjustments: Recessed and concealed.
 6. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.
 7. Bypass Switch: Override the on function in case of sensor failure.
 8. Power Supply and Slave Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.
 9. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.
 10. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.
 11. Warranty: Five (5) year warranty.
- B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit.
1. **[SW-VS-D] or [SW-OC-D]:** 360 Degree Coverage Pattern:
 - a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay, integrated isolated relay contact. Sensor shall control all circuits in area, unless noted otherwise. Initial settings: ambient sensor 40 FC.
 - b. Approved Manufacturers: Watt Stopper DT 300 Series, Hubbell OMNI-DT2000 or ATD2000C, Greengate OAC-DT, Leviton OSC##-MOW.
 2. **[SW-VS-D-W] or [SW-OC-D-W]:** Wall Mounted on Adjustable Swivel Mount:
 - a. Wall or ceiling sensor with adjustable settings to allow manual on/auto off or auto on/auto off. Integrated ambient light level sensor (2 to 100 FC range).
 - b. Approved Manufacturers: Watt Stopper DT-200 Series, Hubbell LODTRP, Leviton OSM12-M series.

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3. **[SW-O]:** Wall Switch:
 - a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.
 - b. Approved Manufacturers: Watt Stopper DW-100 Series, Hubbell LHMTS, Leviton OSSMT series.
 4. **[SW-O2]:** Wall Switch:
 - a. Multi-relay wall switch with manual on/auto off for two separate loads. 120/277 VAC load relay rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.
 - b. Approved Manufacturers: Watt Stopper DW-200 Series, Hubbell LHMTD, Leviton OSSMD series.
 5. Sensitivity Adjustment: Separate for each sensing technology.
 6. Detection Coverage:
 - a. Task Areas: Detect occupancy anywhere in an area based on hand motion.
 - b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking motion.
 - C. Mask sensors where necessary to prevent nuisance switching from adjacent areas.
 - D. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.
 1. **[SW-OC-P-HA]:** High Bay - Aisle Coverage Pattern:
 - a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all luminaires in area. Initial settings: Time delay 10 minutes.
 - b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.
 2. **[SW-OC-P-HB]:** High Bay - 360 Degree Coverage Pattern:
 - a. 20' to 40' mounting height. Minimum 1.3:1 walking motion coverage pattern to height ratio. Adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all luminaires in area.
 - b. Approved Manufacturers: Watt Stopper HB-300 Series, Hubbell FHB 140 or HMHB series, Leviton OSFHU, Greengate OEF-P.
 3. **[SW-OC-P-O]:** Wall Switch Occupancy Sensor:
 - a. Passive infrared, zero crossing circuitry, adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC.
 - b. Approved Manufacturers: Watt Stopper PW-100 Series, Sensor Switch WSX, Hubbell LHRS1 or AP1277, Leviton ODS15, Greengate OSW-P-0451.

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4. **[SW-OC-D-D]:** Wall Occupancy Sensor with Dimmer:
 - a. Dual technology sensing with either technology maintaining the ON status. Integrated ambient light level sensor. Adjustable time delay.
 - b. Approved Manufacturers: Sensor Switch WSX D series.
 5. **[SW-OC-P-O2]:** Dual Wall Switch Occupancy Sensor:
 - a. Passive infrared, zero crossing circuitry. Switches control two separate circuits or relays, adjustable sensitivity and time delay, no minimum load requirements, manual or auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC.
 - b. Approved Manufacturers: Watt Stopper PW-200 Series, Sensor Switch WSD-2, Hubbell LHIRD2 or AP127712, Leviton ODS, Greengate OSW-P-0451.
 6. **[SW-OC-P-P]:** Ceiling Mounted - 360 Degree Coverage Pattern:
 - a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.
 - b. Approved Manufacturers: Watt Stopper CI Series, Sensor Switch CM-9, Hubbell Automation Omni-IR, Leviton OSC Series, Greengate OMR-P Series.
 7. **[SW-OC-P-P2]:** Ceiling Mounted - 100 Degree Coverage Pattern:
 - a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40 FC.
 - b. Approved Manufacturers: Watt Stopper WPIR Series, Sensor Switch CM-9, Hubbell LOIRWV or ATD1600W.
 8. **[SW-OC-P-W]:** Wall Mounted - 100 Degree Coverage Pattern:
 - a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise. Initial settings: Ambient sensor 40 FC.
 - b. Approved Manufacturers: Watt Stopper WPIR Series, Sensor Switch CM-9, Hubbell LOIRWV or ATD1600W.
 9. **[SW-O]:** Wall Switch:
 - a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.
 - b. Approved Manufacturers: Watt Stopper PW-100 Series, Hubbell LHIRS, Leviton ODS series.

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10. **[SW-O2]:** Wall Switch:
 - a. Multi-relay wall switch with manual on/auto off for two separate loads. 120/277 VAC load relay rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x 15' pattern.
 - b. Approved Manufacturers: Watt Stopper PW-200 Series, Hubbell LHIRD, Leviton ODS-OD series.
 11. With daylight filter and lens to afford coverage applicable to space to be controlled.
- E. Ultrasonic Type: Ceiling mounting. Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
1. **[SW-OC-U]:** 360 Degree 20' x 20' Hand Motion Coverage Pattern:
 - a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated 1 amp relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.
 - b. Approved Manufacturers: Watt Stopper WT-1100 series, Hubbell OMNI-US or ATU series, Leviton OSC series, Greengate ODC-U series.
 2. **[SW-OC-U2]:** 35' x 30' Hand Motion Coverage Pattern:
 - a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.
 - b. Approved Manufacturers: Watt Stopper WT-2200 series, Hubbell OMNI-US or ATU series, Leviton OSC series, Greengate ODC-U series.
 3. **[SW-OC-U-A]:** 360 Degree Two Sided Corridor Coverage Pattern:
 - a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.
 - b. Approved Manufacturers: Watt Stopper WT-2250 Series, Hubbell OMNI-US or ATU series, Greengate ODC-U Series.
 4. **[SW-OC-U-W]:** Wall Mounted:
 - a. Wall switch with adjustable settings to allow manual on/auto off or auto on/auto off.
 - b. Approved Manufacturers: Watt Stopper UW-100 Series, Hubbell AU1277I,
 5. Crystal controlled with circuitry that causes no detection interference between adjacent sensors.

2.8 FLOOR BOXES

- A. Color: Verify with Architect.
- B. Coordinate with Technology drawings for voice/data outlet requirements.
- C. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Fully adjustable, cast iron.

-
- D. **[FB-1]:** Cast iron floor box, dual compartment, flush mount, brass carpet flange. One compartment with one (1) **[REC-DUP]** and brass duplex flap cover. One compartment with brass 2-1/8" x 3/4" combination cover and one (1) 3/4" and one (1) 1" conduit stubbed to above the lay-in ceiling.

1. Approved Manufacturers:

- a. Hubbell B4233 (Box), S2425 (Cover), S3825 (Cover), SB3084 (Flange), 5362 (Recept)
- b. Wiremold 880CS2
- c. Steel City 642

2.9 PENDANT CORD/CONNECTOR DEVICES

- A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P and L5-20R, heavy-duty grade or refer to Details as shown on drawings.

1. Body: Nylon with screw-open cable gripping jaws and provisions for attaching external cable grip.

- B. External Cable Grip: Woven wire mesh type made of high strength galvanized steel wire stand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.10 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection, FS/UL listed.

2.11 POKE-THROUGH FITTINGS

- A. UL listed as fire-rated poke-through device for 1, 1-1/2 and 2 hour rated floors: include fire stops and smoke barriers in through-floor component. UL514A listed for scrub locations.

B. Terminate in 4-inch square by 2-1/2 inch deep junction box.

C. Suitable for installation with a floor thickness of 2-1/4 to 7 inches.

D. Semi-flush die-cast aluminum carpet flange.

E. Spring loaded receptacle covers.

F. Verify color with Architect.

- G. **[FB-2]:** Fire-Rated Multi-Service Recessed 8" Poke-Through:

1. Recessed mounted. For use with 8-inch core holes. Provide with two (2) 125 volt, 20 amp, NEMA 5-20R duplex receptacles with 3/4" conduit and junction box. Provide with capacity for 12 data jacks and (1) 1 1/2" and (1) 1" conduit.

2. Cast aluminum cover with separate hinged doors to open 180°. Finish as selected by Architect.

3. Approved Manufacturers: Hubbell S1R8 series, Wiremold 8AT series.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install light switches, dimmers, and convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.
- B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.
- C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions. This Contractor is responsible for taking any measures required to ensure no conduits or other services are damaged. This may include X-ray or similar non-destructive means.
- D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground slot to the left.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.
- F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.
- G. Install devices and wall plates flush and level.
- H. Contractor to verify that wall dimmer ratings are achieved where a ganged installation is used.
- I. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.
- J. Identify locations of power packs, control units, and relays above ceiling on record drawing.
- K. Test receptacles for proper polarity, ground continuity and compliance with requirements.
- L. Floor Box Installation:
 - 1. Set boxes level and flush with finish flooring material.
 - 2. Use cast iron floor boxes for installations in slab on grade. Trim shall match floor covering to be used.
 - 3. Provide a minimum horizontal offset of 24 inches between boxes.
 - 4. Provide saw-cutting and patching of existing concrete floors as necessary for floor box installations within existing floors.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fuses
- B. Spare Fuse Cabinet

1.2 REFERENCES

- A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types
- B. UL 198E - Class R Fuses
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)
- D. NEMA FU 1 - Low Voltage Cartridge Fuses
- E. NFPA 70 – National Electrical Code

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.

1.4 EXTRA MATERIALS

- A. Provide two fuse pullers.
- B. Provide three of each size and type of fuse installed.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40°F (5°C) or more than 100°F (38°C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – FUSES

- A. Cooper Bussman
- B. Eagle Electric Mfg. Co.; Cooper Industries
- C. Mersen
- D. Tracor; Littelfuse Subsidiary

2.2 FUSES

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Fuses with ratings larger than 600 amperes: Class L (time delay), unless otherwise noted on the drawings.
- D. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay), unless otherwise noted on the drawings.

-
- E. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.
 - F. Control transformer fuses: Class CC (time delay).
 - G. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

2.3 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses where indicated on the drawings and specifications.
- B. Install fuses in accordance with manufacturer's instruction.
- C. Install fuses in packaged equipment as required by equipment manufacturer.
- D. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- E. Install spare fuse cabinet in the Main Electrical Room.

END OF SECTION 26 28 13

SECTION 26 28 16 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches
- B. Non-fusible switches
- C. Molded case circuit switches
- D. Molded case switches
- E. Motor disconnect switch
- F. Enclosures

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

- A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.
- C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. **[FDS-#]:** Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.
- B. **[DS-#]:** Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: Type as indicated on the disconnect schedule.
- D. Accessories: As indicated on the disconnect schedule.

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

- A. **[CB-#]:** Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip settings.
 - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t responses.
 - 4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
- B. **[CB-#]:** Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- C. Accessories: As indicated on the disconnect schedule.

2.3 MOTOR DISCONNECT SWITCH

- A. **[DS-#]:** Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- B. Enclosures: Type as indicated on the Disconnect Schedule.
- C. Ground lug connection provided in enclosure.
- D. Accessories: As indicated on the Disconnect Schedule.
- E. Listed UL 508 suitable for motor control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on the drawings.
- B. Install fuses in fusible disconnect switches.
- C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.2 ADJUSTING

- A. Set field-adjustable circuit breaker trip ranges.

END OF SECTION 26 28 16

SECTION 26 28 21 - CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General-purpose contactors
- B. Lighting contactors
- C. Enclosures

1.2 RELATED SECTIONS AND WORK

- A. Refer to Lighting Contactor Schedule.

1.3 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- C. UL 508 - Industrial Control Equipment

1.4 SUBMITTALS

- A. Submit shop drawings under provisions of Section 26 05 00.
- B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, and poles.
- C. Submit manufacturer's instructions under provisions of Section 26 05 00.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric
- B. G.E.
- C. ASCO

2.2 **[C-#]:** GENERAL-PURPOSE CONTACTORS

- A. Contactors: NEMA ICS 2 and UL 508; electrically held, 2-wire control.
- B. Coil Operating Voltage: 120 volts, 60 Hertz.
- C. Size: NEMA ICS 2; size as indicated on the drawings.
- D. Contacts: 600 volts, 60 Hertz.
- E. Enclosure: ANSI/NEMA ICS 6; Type 1.
- F. Provide solderless pressure wire terminals.

2.3 [LC-#]: LIGHTING CONTACTORS

- A. Contactors: NEMA ICS 2 and UL 508; electrically held, 2-wire control.
- B. Coil Operating Voltage: 120 volts, 60 Hertz.
- C. Contacts: As indicated on the drawings.
- D. Enclosure: ANSI/NEMA ICS 6; Type 1.
- E. Provide solderless pressure wire terminals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction boxes: and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION 26 28 21

SECTION 26 31 00
PHOTOVOLTAIC SYSTEM PERFORMANCE REQUIREMENTS

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25
26 **PART 1 - GENERAL**

27
28 **1.1 DESCRIPTION**

- 29 A. This section includes general performance requirements that apply to installing a roof mounted solar electric
30 (PV) system for this project
31 B. Contractor is the Designer of Record for this system. Contractor is required to provide a Structural PE
32 (Professional Engineer) Stamp for the structural design and an Electrical PE Stamp for the overall system design.
33 C. Both the structural and electrical stamps are to be provided from experienced PV designers with at least 5 similar
34 completed projects.
35 D. Contractor is required to have experience with at least 5 similar completed PV projects.
36 E. Product specifications included in this section are the Basis for Design. Design substitutions shall meet the
37 minimum performance requirements defined in this section. Contractor shall select number of inverters and
38 perform string sizing.
39 F. Related Work and Requirements:
40 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and
41 Division 01 Specification Sections, apply to this Section.
42 G. Incentive Paperwork:
43 1. Contractor to provide support with Owner’s application for Focus on Energy incentives.
44

45 **1.2 DEFINITIONS**

- 46 A. MPPT: Maximum power point tracking.
47 B. STC: Standard test conditions, 1000 W/m², 1.5 air mass, and 25°C cell temperature.
48 C. NABCEP: North American Board of Certified Energy Practitioners
49 D. PTC: PV USA Test Conditions, 1000 W/m², 1.5 air mass, 20°C air temperature, and 1 meter/sec. wind speed.
50 E. Voc: Open circuit voltage
51 F. Isc: Short circuit current.
52

53 **1.3 SUBMITTALS**

- 54 A. Experience: Submit resumes for individuals involved with the design and construction of the PV System. Submit
55 references and summaries of five similar projects that these individuals have completed.
56 B. Product Data: For each type of component indicated below. Include rated capacities, operating characteristics,
57 and furnished specialties and accessories. All product data submittals shall be submitted for review by Owner
58 prior to purchasing any materials or equipment.

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1. Solar panels
 2. Combiner boxes and fuses
 3. Grid tied inverters, including efficiency data.
 4. Solar panel structural system, including rail, clamps, and brackets.
 5. Manufacturer's installation instructions.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. All shop drawings shall be submitted for review by Owner prior to purchasing any materials or equipment.
1. Dimensioned AutoCAD plan drawings of equipment including solar panel array, inverters, disconnects, combiner boxes, metering, and electrical routing.
 2. Provide AutoCAD drafted three-line wiring diagram of solar PV system indicating ratings of all panels and inverters, wire and conduit types and sizes, and disconnects.
 3. Wiring Diagrams: Power, signal, and control wiring.
- D. Design Calculations
1. The following design calculations shall be performed by Contractor and submitted for review by Owner prior to purchasing any materials or equipment.
 - a. Electrical calculations, including string sizing, inverter selection, and voltage losses.
 - b. Structural calculations, including rail spans, wind and snow loading, required ballast weights, and roof strength calculations.
- E. Permitting and Agreements
1. The following permits and agreements shall be prepared by Contractor on behalf of the Owner. All approved permits and agreements shall be submitted for review by Owner prior to purchasing any materials or equipment.
 - a. Utility interconnection agreement
 - b. Building permit
 - c. Electrical permit
- F. As built drawings:
1. Dimensioned AutoCAD plan drawings of equipment including solar panel array, inverters, disconnects, combiner boxes, metering, and electrical routing.
 2. Provide AutoCAD drafted three-line diagram of solar PV system indicating ratings of all panels and inverters, wire and conduit types and sizes, and disconnects.
- G. Field quality-control test reports.
1. Include voltages and power output for each string. Measure and record solar intensity during testing. Include time, date, and weather conditions of test.
- H. Operation and Maintenance Data: For panels, inverter, metering, and monitoring. In addition to items specified in Division 01 include the following:
1. Instructions for operating equipment.
 2. Identification of operating limits which may result in hazardous or unsafe conditions.
 3. Document ratings of equipment and each major component.
 4. Technical Data Sheets.
 5. Wiring Diagrams.
 6. Parts list.
- I. Warranty: Copies of all manufacturer's and installer's warranties.

1.4 QUALITY ASSURANCE

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- A. Installer Qualifications:
1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
 2. Installer must have PV Installer certification through NABCEP.
- B. Source Limitations: Obtain panels from a single manufacturer, of a single type and rating. Obtain inverters from a single manufacturer, of a single type and a single rating.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70 and all applicable state and local codes

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1.5 COORDINATION

- A. Coordinate metering and interconnection agreement with electric utility. Contractor shall pay all interconnection fees including the application review fee, engineering review fee, and distribution system study fee. Contractor shall submit all required forms to utility.

1.6 WARRANTY

- A. Installer must provide a two year installation warranty covering any defects of the installation.
- B. Panel Warranty Period:
 - 1. 5 years workmanship warranty.
 - 2. 10 year 90% linear power output warranty.
 - 3. 25 year 80% linear power output warranty.
- C. Inverter Warranty Period: 15 year warranty.

PART 2 - PRODUCTS

2.1 SOLAR PANELS

- A. Available Manufacturers: Subject to compliance with performance requirements, manufacturers offering products that may be incorporated into the Work include:
 - 1. Solar World Sunmodule Plus SW300 Mono
- B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.
- C. Capacities and Characteristics:
 - 1. All panels shall be of a single type from a single manufacturer.
 - 2. Power Output Ratings: STC rated power of between 285 and 300 watts.
 - 3. Power tolerance of less than 5% variation (maximum minus minimum). Minimum tolerance of -0%.
 - 4. Manufactured in the U.S., Mexico or Canada
 - 5. Nameplates: To identify electrical characteristics, manufacturer's name and address, and model and serial number of component.
 - 6. Module efficiency: minimum 17.00%
- D. Materials and construction
 - 1. Monocrystalline
 - 2. Junction box with bypass diodes.
 - 3. Output Connections: Factory wired separate positive and negative leads sized per division 26 wire requirements with locking quick disconnects, rated for use in direct sunlight. Shall meet all requirements of NEC article 690.33.
 - 4. Anodized aluminum frame with drainage holes and grounding holes.
 - 5. Operating temperature range of -40°C to +85°C.
 - 6. Withstand 1" diameter hail at 50 mph without damage.
 - 7. Load rated at 5400 Pa (113 psf) when used with two rail system.

2.2 INVERTERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:
 - 1. SMA
 - 2. Fronius
 - 3. Solar Edge with P600 Optimizers (1 Optimizer per 2 panels)
- B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.
- C. Standards
 - 1. IEEE 1547
 - 2. UL 1741 – anti-islanding.
- D. Electrical characteristics
 - 1. AC kW rating:
 - a. Provide (2) inverters rated for a total of 21.6 kW DC input
 - 2. Output voltage: 480VAC (-12%, +10%), 3 phase.
 - 3. Frequency: 60 Hz sine wave
 - 4. Input voltage: Coordinated with solar array.

- 1 5. Max Voc: Coordinated with solar array.
- 2 6. Max DC current: Coordinated with solar array.
- 3 7. Startup voltage: Coordinated with solar array.
- 4 8. Output power factor: Unity
- 5 9. DC to AC conversion efficiency:
- 6 a. 97.5% CEC rated efficiency
- 7 10. A/C and D/C rapid shutdown compliant with NEC 2017
- 8 E. Features
- 9 1. Transformerless design.
- 10 2. Forward facing DC disconnect
- 11 3. DC side ground fault protection.
- 12 4. Inverter must limit power output to nameplate value. If connected to an array capable of producing
- 13 more than the inverter's capacity, the inverter must limit the power without damage.
- 14 5. Maximum power point tracking over the range of voltages of the array, at the ambient temperatures of
- 15 the site.
- 16 6. User navigable display.
- 17 7. LED status lights on enclosure.
- 18 8. Communication port for diagnostics and communication port for communication with multiple inverters
- 19 and internet interface device.
- 20 9. NEMA 3R enclosure
- 21

2.3 PV WIRING

- 22 A. Type USE-2, #10AWG, from array to combiner box, and where used as a jumper for connection between panels.
- 23 B. UV-Stabilized Cable Ties:
- 24 1. Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self
- 25 locking, Type 6/6 nylon.
- 26 2. Minimum Width: 3/16 inch (5 mm).
- 27 3. Tensile Strength at 73 °F (23 °C), According to ASTM D 638: 12,000 psi (82.7 MPa).
- 28 4. Temperature Range: -40 to +185 °F (-40 to +85 °C).
- 29 5. Color: Black.
- 30 C. Ampacity of PV source circuits shall be a minimum of 156% of the sum of parallel strings short circuit currents.
- 31 Where installed exposed to direct sunlight, ampacity shall include adjustment for ambient temperature per NEC
- 32 article 310.15.
- 33 1. Shall be sized to limit voltage drop to 1.5% from array to inverter during full production at MPPT voltage
- 34 at maximum ambient temperature.
- 35 2. Shall be in metallic conduit from combiner box to inverter.
- 36
- 37

2.4 COMBINER BOX

- 38 A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may
- 39 be incorporated into the Work include:
- 40 1. Blue Oak
- 41 2. SMA
- 42 3. MidNite solar
- 43 B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the
- 44 owner. Follow substitution request procedure per 01 25 13.
- 45 C. Capacities and Characteristics:
- 46 1. DC current and voltage ratings coordinated with array.
- 47 2. Positive and negative combiner blocks.
- 48 a. Number of poles coordinated with array.
- 49 3. DC voltage fuses in fingersafe fuse holder.
- 50 D. Materials and construction
- 51 1. Powder coated steel, NEMA 3R enclosure.
- 52 2. Knockouts
- 53 3. Stainless steel hardware.
- 54
- 55

2.5 RACKING & ROOF ATTACHMENT & ROOF PENETRATIONS

- 56 A. Tilt Angle of Panels: 25 degrees from horizontal
- 57

- 1 B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may
2 be incorporated into the Work include:
3 1. Products for systems on flat roofs:
4 a. Anchor Products, <http://www.anchorp.com/> , U-anchor 2000 EPDM
5

6 **2.6 METERING**

- 7 A. Refer to Division 26 specifications.
8

9 **2.7 INTERNET BASED MONITORING**

- 10 A. Provide standard package from inverter manufacturer
11

12 **PART 3 EXECUTION**

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14 **3.1 EXAMINATION**

- 15 A. Examine roughing-in of electrical connections. Verify actual locations of connections before panel installation.
16 B. Proceed with installation only after unsatisfactory conditions have been corrected.
17

18 **3.2 ARRAY REQUIREMENTS**

- 19 A. Install panels on racking designed for solar (PV) panels.
20 B. Coordinate installation with roof shop drawings.
21 C. Structural Performance: Installation shall withstand all local wind and snow loads, and all local building
22 department requirements.
23 D. Slip sheet is to be used between ballasted racking and roof membrane
24 E. All fastening hardware must be stainless steel.
25 F. All materials must be metallurgically compatible where different materials are in contact with each other.
26 G. Roof penetrations shall be made watertight using methods that are standard to the roofing industry, are
27 approved by the roofing manufacturer, and that protect the warranty of the roof.
28 H. The panels shall be connected in arrays with the following characteristics:
29 1. Total DC peak STC rated power of all panels in the array shall be minimum **21.6 kW**. The panels shall be
30 divided into even arrays between the inverters.
31 2. The panels shall be installed only in the area outlined on the architectural roof drawing.
32 3. If an alternate layout is proposed, bid is to document how the proposed solution is more cost effective to
33 the owner. Follow substitution request procedure per 01 25 13.
34 4. Each array shall be provided with a combiner box.
35 5. The panels shall be installed with long axis running north south.
36 6. PV panel cables may be installed exposed where routed directly behind panels, but all cables shall be
37 installed in a section of conduit where crossing part of the roof not under a panel. Conduit running
38 across roof shall be supported on roof using Cooper B-Line Dura-Blok or equivalent.
39 7. All PV panel cables shall be installed in a neat and workmanship like manner. Excess wire shall be coiled
40 and bundled neatly and supported securely in an area where they are not subject to environmental
41 degradation, such as from wind, sun, and animals. Attach PV panel cables to racking with zip-ties listed
42 for use in direct sunlight.
43 8. Panels shall be connected in series and parallel to match voltage and current ratings of inverter, across all
44 ambient temperatures common to site (-25°C to 40°C).
45 a. Open circuit voltage of array on coldest day of year in full sunlight shall not exceed maximum
46 operating voltage rating of inverter, panels, or any other equipment.
47 b. Open circuit voltage on warmest day of year in morning sunlight conditions (200W/m2 irradiance)
48 shall exceed inverter startup voltage. Voltage under operating MPPT conditions, minus any
49 voltage drop over conductors, shall exceed minimum inverter input voltage.
50 c. Available short circuit current multiplied by 1.25 shall not exceed ratings for the inverter or any
51 panels.
52 d. All series strings of panels shall have same performance characteristics.
53

54 **3.3 ELECTRICAL INSTALLATION**

- 55 A. Ground equipment according to Division 26
56 1. Size grounding conductors per NEC articles 250 and 690.
57 2. All conductive equipment enclosures must be grounded.
58 3. All panel frames must be grounded.

- 1 a. The removal of any panel shall not interrupt a grounded conductor to another photovoltaic
2 source circuit.
3 B. Install wiring, combiner boxes, conduit, disconnects, inverter, web based monitoring hardware, sensors and
4 other equipment according to Division 26.
5 C. Connect wiring according to Division 26.
6

7 **3.4 IDENTIFICATION**

- 8 A. Identify and label system components according to Division 26.
9 1. Provide a unique label for each inverter, PV output circuit, combiner box, PV Source circuit, and panel.
10 Labeling shall match labeling shown on as-built diagram and plan provided by contractor.
11 B. Provide all labeling required by NEC article 690, including, but not limited to:
12 1. Label disconnects capable of being energized from both directions as such.
13 2. Provide plaque at utility service disconnect per article 690.56B. Field verify exact location.
14 3. Label each photovoltaic disconnecting means per NEC article 690.53.
15

16 **3.5 FIELD QUALITY CONTROL**

- 17 A. Perform tests and inspections as indicated below and prepare test reports. Correct any deficiencies.
18 1. Visually inspect all connections.
19 2. Visually inspect all supports.
20 3. Measure Voc of each individual string of panels under full sunlight.
21 a. Verify Voc of all strings are balanced.
22 b. Verify measured Voc against calculated Voc for the ambient temperature. Extrapolate Voc to
23 temperatures expected at site, and verify they are within inverters ratings.
24 4. Measure Isc of each string of panels.
25 5. Verify correct operation of inverter.
26 6. Verify correct operation of complete system.
27 7. Replace any defective panels. Panels shall be replaced at contractor's expense.
28

29 **3.6 DEMONSTRATION**

- 30 A. Simulate power outage by interrupting normal source, and demonstrate that system disconnects from utility.
31 B. Provide owner's maintenance personnel with minimum two hour training session and in compliance with Div 1
32 Training Requirements.
33 1. Provide training on function of each piece of equipment.
34 2. Provide training on maintaining the system.
35 3. Explain means of disconnecting the system, and principals of operation and safety.
36

37
38 **END OF SECTION**
39

SECTION 26 32 13 - PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Packaged engine generator system
- B. Exhaust silencer and fittings
- C. Fuel fittings and day tank
- D. Remote annunciator panel
- E. Battery and charger
- F. Weatherproof enclosure

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 22 30 00 - Plumbing Equipment
- B. Section 23 21 00 - Hydronic Piping
- C. Section 23 57 00 - Heat Exchangers

1.3 REFERENCES

- A. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- B. ANSI/NEMA MG 1 - Motors and Generators
- C. ANSI/NFPA 70 - National Electrical Code
- D. ANSI/NFPA 99 - Health Care Facilities
- E. ANSI/NEMA AB 1 - Molded Case Circuit Breakers
- F. NFPA 37 – Installation and Use of Stationary Combustion Engines and Gas Turbines
- G. NFPA 110 – Emergency and Standby Power Systems
- H. Environmental Protection Agency EPA Emission Standards for Compressed Ignition Engines
- I. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at property boundaries due to sound emitted by the generator set, its components and the operation thereof.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Submit shop drawings showing plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
- C. Submit product data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, remote radiator, and remote annunciator.
- D. Submit certificates for compliance with EPA Emissions Standards for Compressed Ignition Engines.
- E. Submit manufacturer's installation instructions under provisions of Section 26 05 00.

1.5 EXTRA MATERIALS

- A. Submit maintenance materials under provisions of Section 26 05 00.
- B. Furnish one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal toolbox.
- C. Provide two additional sets of each fuel, oil, and air filter element required for the engine generator system. Provide additional fuel polishing filters for one year of operation.
- D. Provide one fuse for every type and rating used.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.
- C. Accept packaged engine generator set and accessories on site in crates and verify damage.
- D. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

1.7 SYSTEM DESCRIPTION

- A. Engine generator system to provide source of emergency and standby power.
- B. System Capacity: as shown on drawings, at an elevation of 1,000 feet above sea level, and ambient temperature between -20°F and 110°F; standby rating using engine-mounted radiator.
- C. Emergency Power Supply System (EPSS) shall be NFPA 110 Type 10 Class 2 Level 1.
- D. Operation: In accordance with ANSI/NFPA 99.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit record documents under provisions of Section 26 05 00.
- B. Accurately record location of engine generator and mechanical and electrical connections.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in packaged engine generator system with minimum five (5) years documented experience.
- B. Supplier: Authorized distributor of engine generator manufacturer with service facilities within 50 miles of the project site.

1.11 WARRANTY

- A. Provide a five (5) year warranty under provisions of Section 26 05 00.

1.12 MAINTENANCE SERVICE

- A. Furnish service and maintenance of packaged engine generator system for one (1) year from Date of Substantial Completion. Maintenance service shall be performed by skilled employees of manufacturer's designated service organization. Include quarterly exercising, and routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts, supplies, and labor.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cummins Power Generation.
- B. MTU On Site Energy
- C. Generac

2.2 **[GEN-#]:** PACKAGED ENGINE-GENERATOR SET

- A. Packaged engine-generator set shall be a coordinated assembly of compatible components.
- B. Safety Standard: Comply with ASME B15.1 and UL 2200.
- C. Nameplates: Each major system component shall be equipped with a nameplate to identify manufacturer's name and address, model and serial number, and component rating in integrated set and as required by the contract documents.
- D. Fabricate engine-generator set mounting frame and attachment of components to resist generator-set movement during a seismic event when generator-set mounting frame is anchored to building structure.
- E. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components. Provide a rigging diagram permanently attached to the mounting frame to indicate the capacity of each lifting attachment and the generator-set center of gravity.
- F. Maximum Dimensions: 210" L x 72" W x 115" H.

2.3 ENGINE

- A. Type: Water-cooled in-line or V-type, four-stroke cycle spark-ignition internal combustion engine.
- B. Rating: Sufficient to operate at 100 percent load for two hours at specified elevation and ambient limits.
- C. Fuel: Appropriate for use of natural gas.
- D. Engine Speed: 1800 RPM.
- E. Governor: Isochronous type with speed sensing.
- F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer.
- G. Frequency Response:
 - 1. Steady State Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

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2. Transient Response: Less than 5 percent for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady state operating band within 5 seconds.
- H. Fuel System: Natural gas system carburetor, secondary gas regulator, fuel shutoff solenoid valve, and flexible fuel connectors.
 - I. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90°F, and suitable for operation on 480-3Ø volts AC. The minimum wattage of the heater shall be 4000 watts or as recommended by the manufacturer.
 - J. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator set mounting frame and integral engine-driven coolant pump.
 1. Fan and Core: Nonferrous-metal construction sized to contain expansion of total system. Blower type fan, sized to maintain safe engine temperature in ambient temperature of 110°F. Radiator Airflow Restriction: 0.5 inches of water, maximum.
 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anti-corrosive additives.
 3. Provide expansion tank with gage glass and petcock, and self-contained, thermostatic-control temperature control valve.
 - K. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel. Provide the following accessories:
 1. Battery: Voltage to match starter with capacity for three cranking cycles without recharge. Provide with battery cables and acid resistant battery tray.
 2. Battery-Charging Alternator: Factory mounted on engine with solid state voltage regulation.
 3. **[BC-#]**: Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Provide wall-mounted enclosure to meet ANSI/NEMA 250, Type 1 requirements.
 - L. Exhaust System: Critical type silencer (85 dBA max at 10 feet), side inlet with muffler companion flanges and flexible stainless steel exhaust fitting, suitable for horizontal orientation, sized in accordance with engine manufacturer's instructions. Silencer shall include a threaded opening for connection of ¾" drain line. Opening shall be flush on inside of silencer.
 - M. The packaged engine generator shall comply with the current Environmental Protection Agency EPA Emissions standards.
 - N. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine-generator control panel.
 - O. Mounting: Provide unit with suitable spring-type vibration isolators.

2.4 GENERATOR

- A. Generator: ANSI/NEMA MG 1; three phase, re-connectible brushless synchronous generator with brushless exciter and PMG alternator excitation.
- B. Rating: As indicated on the drawings, at 0.8 power factor, 60 Hertz at RPM to match engine rating.

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- C. Insulation: ANSI/NEMA MG 1, Class F.
 - D. Temperature Rise: 105°C continuous.
 - E. Enclosure: ANSI/NEMA MG 1; open drip-proof.
 - F. Voltage Regulation:
 - 1. The maximum instantaneous voltage dip (IVD) shall be 30 percent.
 - 2. Include solid-state type voltage regulator, separate from exciter to match engine and generator characteristics, with voltage regulation ± 1 percent from no load to full load. Include manual controls to adjust voltage drop ± 5 percent voltage level, and voltage gain.
 - G. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
 - H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

2.5 CONTROLS AND INDICATION

- A. Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
- B. Ground Fault: Provide ground fault sensing at the generator. The sensor shall be located ahead of the generator service disconnect. Provide a ground fault indication on the engine-generator control panel. Provide an instruction nameplate at the control panel.
 - 1. Instruction nameplate: Provide operational instructions for a ground fault indication as approved by the local Authority Having Jurisdiction.
- C. **[GCP-#]:** Engine-Generator Control Panel: ANSI/NEMA 250, Type 1 generator mounted control panel enclosure with engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
 - 1. Alarm indication as required by NFPA 110 for a Level 1 system.
 - 2. AC frequency meter.
 - 3. AC output voltmeter with phase selector switch.
 - 4. AC output ammeter with phase selector switch.
 - 5. Output voltage adjustment.
 - 6. DC voltmeter (alternator battery charging).
 - 7. Engine start/stop selector switch.
 - 8. Engine running time meter.
 - 9. Oil pressure gauge.
 - 10. Engine coolant temperature gauge.
 - 11. Shut down devices for overspeed, coolant high-temperature, coolant low-level, and oil low-pressure.
 - 12. Fuel derangement alarm.
 - 13. Generator overload.
 - 14. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
 - 15. Remote Alarm Contacts: Pre-wire SPST contacts to terminal strip for remote alarm functions required by ANSI/NFPA 99.
 - 16. Ground fault indication.

D. **[GAP-#]:** Remote Engine Annunciator Panel: ANSI/NFPA 99 and NFPA 110 for a Level 1 system. Include the listed pre-alarm and alarm points, audible alarm, alarm silencing means, repetitive alarm circuitry, and lamp test switch in a surface mounted panel with brushed stainless steel finish. Provide all interconnecting wiring in conduit per manufacturer's requirements by the Electrical Contractor. The remotely reported alarms shall include the following.

1. Overcrank
2. Low water (engine) temperature
3. High engine temperature prealarm
4. High engine temperature
5. Low lube oil pressure prealarm
6. Low lube oil pressure
7. Overspeed
8. Low coolant level
9. Not in auto
10. Emergency Power Supply (EPS) supplying load
11. High battery voltage
12. Low battery voltage
13. Battery charger failure (includes AC failure)
14. Generator running
15. Normal utility power
16. Emergency stop
17. Emergency Power Off Switch activated (EPO)
18. Alarm for power supply or UPS serving motorized breakers

E. Building Automation System Integration:

1. Provide a terminal block to allow the Facility Monitoring and Control System (FMCS) to report generator general alarm. Refer to Specification Section 23 09 00 for alarms reported by the FMCS.

2.6 ACCESSORIES

A. Generator Circuit Breaker: Molded or insulated case, service-rated electronic trip type; 100% rated breaker complying with NEMA AB1 and UL 489.

1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator is shut down by other protective devices.
4. Mounting: Provide freestanding enclosure or mount integrally with control and monitoring panel.

B. **[EPO]:** Remote Manual Stop Station (Emergency Power Off EPO): Provide a remote manual stop station with weather proof stainless steel or die cast housing, red mushroom button - push to stop operation, breakable cover/lens to access mushroom button, 120 volt rated. The manufacturer shall provide automatic monitoring of the EPO switch. Placing the EPO switch in the "Generator Powered OFF" status shall initiate a visual and audible alarm at each generator annunciator panel.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE SKIN-TIGHT

A. Prefabricated or pre-engineered skin tight enclosure with the following features:

1. Construction: Reinforced galvanized steel, metal clad, integral structural steel framed housing anchored to a concrete foundation. Construction shall allow access to control panels and service points. The panels shall enclose all components, including intake/exhaust louvers and sound attenuators. Extend the enclosure base frame as required for panels.

-
2. The generator control panel shall be located no greater than 5'-0" above finished grade for ease of access.
 3. Structural Design and Anchorage: Wind resistant up to 100 mph.
 4. Louvers: Equipped with bird screen and filter arranged to permit air circulation when engine is not running while excluding exterior dust, birds, and rodents. Motor operators shall be spring open, power close operating at 24 volts DC. The louvers shall be connected to the generator starting batteries through appropriate control relays.
 5. Hinged Doors: Provide a minimum of four doors with padlocking provisions. Single doors shall be 36" wide and 84" high. Double doors shall be 60" wide and 84" high. As standard, doors shall include rain-rail moldings above all door openings, recessed, keyed mortise locks, panic bar door hardware and full weather-stripping. Doors shall be removable.
 6. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits as required by engine-generator-set components.
 7. The exhaust system silencer shall be installed within the enclosure housing.
 8. Acoustical Treatment: Provide acoustical treatment of the generator enclosure including wall panels, intake and exhaust air paths, ventilation openings, and tailpipe exhaust. Maximum sound level horizontally from the generator set shall be 70 dBA at 33 feet in a hemispherical free field in the configuration shown on the drawings. Sound attenuators shall be concealed within the enclosure panels. Panels shall extend from the enclosure base frame to the height of the generator section.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and field dimensions are as shown on the drawings.
- B. Verify that required utilities are available in proper location and ready for use.
- C. Beginning of installation means installer accepts existing conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install remote manual stop station in location shown on plans. Provide 120 Volt power and wiring in conduit as required. Coordinate installation with the manufacturer approved shop drawings and wiring diagrams. The remote manual stop station shall shunt trip the generator mounted circuit breaker and signal the engine prime mover to stop.
- C. The A-B-C phase rotation of the generator source shall match the A-B-C phase rotation of the utility source. The Contractor shall verify the generator and utility phase rotation match to prevent three phase motors and similar loads from operating backwards while being served by the generator.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 26 05 00 and in compliance with NFPA 110 requirements.

-
- B. Provide portable test bank for full load test, if required. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal.
- C. Fill fuel tank prior to start of test.
- D. The on-site installation test shall be conducted as follows:
1. With the prime mover in a "cold start" condition and the emergency load at standard operating level, a primary power failure shall be initiated by opening all switches or breakers supplying the primary power to the building or facility.
 2. The test load shall be that load that is served by the Emergency Power Supply System (EPSS).
 3. The time delay on start shall be observed and recorded.
 4. The cranking time until the prime mover starts and runs shall be observed and recorded.
 5. The time taken to reach operating speed shall be observed and recorded.
 6. The voltage and frequency overshoot shall be recorded.
 7. The time delay on transfer to emergency power for each switch shall be recorded. Life safety and critical branch transfer switches must transfer within 10 seconds.
 8. The time taken to achieve a steady-state condition with all switches transferred to the emergency position shall be observed and recorded.
 9. The voltage, frequency, and amperes shall be recorded.
 10. The prime mover oil pressure and water temperature shall be recorded, where applicable.
 11. The battery charge rate shall be recorded at 5-minute intervals for the first 15 minutes and at 15 minute intervals thereafter.
 12. When primary power is returned to the building or facility, the time delay on retransfer to primary for each switch with a minimum setting of 5 minutes shall be recorded.
 13. The time delay on the prime mover cool down period and shutdown shall be recorded.
 14. Allow prime mover to cool for 5 minutes.
 15. A load shall be applied for 4 hours total. The building load shall be permitted to serve as part or all of the load, supplemented by a load bank of sufficient size to provide a load equal to 100 percent of the nameplate rating of the Emergency Power Supply (EPS), less applicable derating factors for site conditions. Observe and record load changes and the resultant effect on voltage and frequency.
 16. The full load test shall be initiated immediately after the cooling time has expired by any method that starts the prime mover and, immediately upon reaching rated rpm, picks up 100 percent of the nameplate kW rating on one step, less applicable derating factors for site conditions.
 17. During test, record the following at 5-minute intervals for the first 15 minutes and every 15 minutes for the rest of the test:
 - a. Kilowatts
 - b. Amperes
 - c. Voltage
 - d. Frequency
 - e. Coolant temperature
 - f. Enclosure temperature (interior)
 - g. Oil pressure

-
- h. Engine exhaust temperature
 - i. Engine inlet temperature
 - j. Oil Temperature
 - k. Battery charge rate

18. Upon completion of the test and after a cool down period, the crank/rest cycle shall be tested.

- a. Any method recommended by the manufacturer for the cycle crank test shall be utilized to prevent the prime mover from running.
- b. The control switch shall be set at "run" to cause the prime mover to crank.
- c. The complete crank/rest cycle shall be observed and recorded.

19. Test alarm and shutdown circuits by simulating conditions.

E. Contractor shall fill fuel tanks upon completion of test.

F. Testing documentation shall be submitted to the Architect/Engineer for review and approval.

G. Generator testing worksheets are included with this specification section.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare, start, test, and adjust systems under provisions of Section 26 05 00.

3.5 ADJUSTING

A. Adjust generator output voltage and engine speed.

3.6 CLEANING

A. Clean work under provisions of Section 26 05 00.

B. Clean engine and generator surfaces. Replace oil and fuel filters.

3.7 DEMONSTRATION

A. Provide systems demonstration. Coordinate the demonstration schedule with the Owner and Architect/Engineer.

B. Describe loads connected to emergency and standby systems and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency and standby power.

END OF SECTION 26 32 13

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DATE: _____
 CUSTOMER: _____
 ENGINE MODEL: _____
 GENERATOR MODEL: _____
 UNIT RATING: _____

W.O.# _____
 S/N: _____
 S/N: _____
 PKG _____

BATTERY VOLT: 24
 VOLTAGE: 480
 FUEL TYPE: Natural Gas
 TESTED BY: _____

kW: 400
 KVA: 500
 PHASE: 3
 HERTZ: 60
 RPM: 1800

ELAPSED TIME	DURATION	1	2	3	1	2	3	KW	TARGET	HZ	RPM	HOUR METER	P.F.	OIL PRESS.	FUEL PRESS.	AMBIENT AIR TEMP.	ENGINE WATER TEMP.	EXHAUST TEMP		ENGINE OIL TEMP.	IN.HG BOOST	COOLANT AT HEAT EXCH. OR RADIATOR		COOLANT AT THE ENGINE		
		VOLTS	VOLTS	VOLTS	AMPS	AMPS	AMPS		KW									L	R			OUT	IN	OUT	IN	
0:10	0:10																									
0:20	0:10																									
0:40	0:20																									
1:00	0:20																									
1:20	0:20																									
1:40	0:20																									
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3:00	0:20																									
3:20	0:20																									
3:40	0:20																									
4:00	0:20																									
4:10	0:10																									
4:20	0:10																									
4:25	0:05																									

Load Profile Time Load %
 10 Min 25%
 10 Min 50%
 4 Hours 100%
 10 Min 110%
 10 Min 50%
 5 Min 0%

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SECTION 26 36 00 - TRANSFER SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Automatic transfer switch **[ATS-#]**

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Transfer Switch Schedule for rating and configuration.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in automatic transfer equipment with three (3) years documented experience.

1.4 REFERENCES

- A. NEMA ICS 1 - General Standards for Industrial Control and Systems
- B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies
- C. NEMA ICS 2-447 - AC Automatic Transfer Switches
- D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- E. UL 1008 - Standard for Automatic Transfer Switches

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00.
- B. Submit product data for transfer switches showing overall dimensions, electrical connections, electrical ratings, and environmental requirements.
- C. Submit manufacturer's installation instructions under provisions of Section 26 05 00.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 26 05 00.
- B. Include instructions for operating equipment.
- C. Include instructions for operating equipment under emergency conditions when engine generator is running.
- D. Identify operating limits which may result in hazardous or unsafe conditions.
- E. Document ratings of equipment and each major component.
- F. Include routine preventive maintenance and lubrication schedule.
- G. List special tools, maintenance materials, and replacement parts.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for emergency and standby electrical systems.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. ASCO.
- B. Russelectric, Inc.
- C. GE Zenith

2.2 AUTOMATIC TRANSFER SWITCH

- A. Description: NEMA ICS 2; automatic transfer switch.
- B. Configuration: Electrically-operated, mechanically-held transfer switch.
- C. Control panel shall be micro-processor based.

2.3 AUTOMATIC TRANSFER AND BYPASS/ISOLATION SWITCH

- A. Description: NEMA ICS 2; automatic transfer switch with manual bypass switch.
- B. Configuration: Draw-out type electrically-operated, mechanically-held transfer switch with manually-operated CONNECTED, TEST, and DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch.
- C. Bypass Switch Ratings: Match automatic transfer switch for electrical ratings.

2.4 SERVICE CONDITIONS

- A. Service Conditions: NEMA ICS 1.

2.5 RATINGS

- A. Refer to the one-line diagrams for the available interrupting capacity (AIC) of the transfer switch. The transfer switch shall be series rated with the equipment feeding the transfer switch. The series rating shall be the larger of the two AIC values when the AIC rating of the equipment feeding the normal and emergency sides of the transfer switch is not equal.
- B. Series rating with upstream devices shall be allowed per UL-1008.

2.6 AUTOMATIC SEQUENCE OF OPERATION

- A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.
- B. Time Delay to Start Alternate Source Engine Generator: 0 to 10 seconds, adjustable.
- C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.
- D. Time Delay Before Transfer to Alternate Power Source: 0 to 30 seconds, adjustable.
- E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.
- F. Time Delay Before Transfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in event of alternate source failure.
- G. Time Delay Before Engine Shut Down: 0 to 30 minutes, adjustable, of unloaded operation.

2.7 ENCLOSURE

A. Enclosure: NEMA ICS 6; Type 1.

2.8 ACCESSORIES

A. Load Shed:

1. The controller shall be capable of being programmed to automatically shed the connected load from the generator in the event of a user configurable under- frequency, under-voltage or overload condition. Under-frequency shedding shall occur if generator is less than 58Hz for greater than 3 seconds or less than 50 Hz for greater than 0.5 seconds.
2. Switch shall be configurable to pick up an output status relay upon activation of the auto load shed feature. Output shall be usable to trip/isolate downstream loads in the event of an overload.
3. Reset of the auto load shed function shall be via operator reset on display, remote reset contact input, or via network signal.

B. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.

C. Test Switch: Key operated or password protected switch. Mount in cover of enclosure to simulate failure of normal source.

D. Engine Start Signal: Rated 10 amps at 30VDC shall be provided to start the engine generator in the event of a normal source outage.

E. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

F. Transfer Switch Auxiliary Contacts: 2 normally open; 2 normally closed indicating switch to normal source or emergency source.

G. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 Hertz from rated nominal value, values shall be field adjustable.

H. Alternate Source Monitor: Monitor each line of alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent Hertz from rated nominal voltage, values shall be field adjustable.

I. Engine Exerciser: Start engine every 28 days. Run for 30 minutes before shutting down. Each event shall be configurable for Test with Load or Test Without Load. Bypass exerciser control if normal source fails during exercising period.

J. In-Phase Monitor: Inhibit transfer until source and load are within 30 electrical degrees.

K. Provide 2 N.O. and 2 N.C. isolated contacts to indicate:

1. Normal source available.
2. Emergency source available.
3. Exercise mode in operation.

L. An adjustable emergency to normal presignal signal to elevator controller.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as instructed by the manufacturer.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide wiring to elevator controller for emergency source mode and emergency to normal presignal.

END OF SECTION 26 36 00

SECTION 26 43 00 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes materials and installation requirements for low voltage surge protection devices (SPD) for the protection of all AC electrical circuits. SPD equipment to be installed at designated service entrance equipment, distribution panels, electronic equipment, and receptacle devices.

1.2 QUALITY ASSURANCE

- A. The specified unit shall be designed, manufactured, tested and installed in compliance with the above references. The unit shall be "Listed by Underwriters Laboratories" to UL 1449.
- B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.3 REFERENCES

- A. ANSI/IEEE C62.33 – IEEE Guide on Testing of MOV components
- B. ANSI/IEEE C62.35 – IEEE Guide on Testing of SAD components
- C. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits
- D. ANSI/IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits
- E. ANSI/UL 1449 Third Edition (Version 3.0) - UL Standard for Safety for Surge Protective Devices
- F. CBEMA – Computer Business Equipment Manufacturers Association
- G. IEC 664 – International Engineering Consortium, Standard for Clamping Voltage
- H. National Electrical Code 285 - Surge Protection Devices
- I. NFPA 70 - National Electrical Code
- J. UL 67 – Listed for Internal Panelboard Transient Voltage Surge Suppressors
- K. UL 96A – Devices listed as approved for secondary surge arrestors (VZCA)
- L. UL 248-1 - Fusing
- M. UL 1283 – Electromagnetic Interference Filters, Fifth Edition

1.4 SUBMITTALS

- A. Shop Drawings: Should include device dimensions, mounting requirements including wire size and over-current protection device rating, nameplate nomenclature, electrical ratings, short circuit current rating, and test results as indicated below under "Testing, Warranty and Life Expectancy" as provided by an independent test lab or a UL certified test lab for the category(ies) of suppression device(s) specified using the appropriate IEEE test wave. Product data sheets with installation instructions for each size and type of device are required. Shop drawings submitted without the testing data as required by section this section will be rejected.

-
- B. Fuse information: Provide fuse information if required for operation. Include size, manufacturer, time-current chart responses to UL 1449 testing requirements, maximum surge protection capability per mode and phase as limited by the fuse, and verification of repetitive surge protection device operation without system degeneration greater than 10%.

1.5 SPARE PARTS

- A. Surge Protection Modules: Furnish 1 replacement module for each type installed.
- B. Fuses: Furnish to the Owner 3 spare fuses of each type and rating installed.

1.6 TESTING, WARRANTY AND LIFE EXPECTANCY

- A. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.
 - 1. Single pulse surge current capacity: Single pulse surge current tested in a mode at rated surge currents.
 - 2. Single pulse surge current capacity test: An initial UL 1449 defined 1.2 x 50 μ s, 6000V open circuit voltage waveform and an 8 x 20 μ s, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage (VPR).
 - 3. A single 8 x 20 μ s waveform pulse of maximum rated surge current per mode shall then be applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.
- B. Minimum Repetitive Surge Current Capacity:
 - 1. Service entrance suppressor units should be tested repetitively at an independent lab to verify repetitive capacity.
 - 2. Minimum Repetitive Surge Current Capacity Test:
 - a. An initial UL 1449 surge defined as 1.2 x 50 μ s, 6000V open circuit voltage waveform and an 8 x 20 μ s, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage.
 - b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges, defined as a 1.2 x 50 μ s 10kV or 20kV open circuit voltage waveform and an 8 x 20 μ s 10,000A short circuit current waveform, shall then be applied at one-minute intervals.
 - c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.
 - 3. Survival is achieved if the suppression voltage (VPR) does not vary by more than 10%.
 - 4. Proof of such testing shall be the test log generated by the surge generator.
- C. Provide UL 1449 classification white sheet pages indicating the VPR (voltage protection rating) for each SPD unit submitted for this product using the 6kV/3kA combination wave surge.
- D. Warranty: Ten (10) years. Includes workmanship, installation and programming.
- E. No scheduled parts replacement or preventative maintenance shall be required.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. General: The unit shall provide transient voltage suppression, surge current diversion and high-frequency noise attenuation, when connected in parallel to the facilities distribution system. The unit MCOV shall not be less than 115% of the nominal system voltage. Operating frequency shall be for a 60 Hz system. The unit shall provide protection in all normal modes for "wye" and "delta" systems. The short circuit current rating shall be the larger of the listed value on the drawings or as required by the equipment protected.

2.2 RATINGS

A. **[SPD-#]:** Service Entrance Suppressors:

1. For 277/480 volt, 3 phase, 4 wire, type 2, category C3 unit.
 - a. Surge current capacity: 100,000/200,000 amps per protection mode/phase
 - b. Nominal Discharge Current: 20 kA.
 - c. Mounting: Refer to the drawings.
 - d. Voltage Protection Rating: Refer to requirements below.
 - e. Components: Minimum component size of 20mm metal oxide varistors (MOV).
 - f. Disconnect: Surge-rated disconnect with 200,000 SCCR.
2. Approved Manufacturers:
 - a. Square D Surelogic EMA Series
 - b. Siemens TPS3 Series
 - c. Current Technology Current Guard Plus
 - d. Emerson Network Power 560 Series
 - e. LEA International LSS Series

B. Voltage Protection Rating:

1. Protection modes and UL 1449 voltage protection rating for surge suppression units per each mode (L-N, L-L, L-G, and N-G as appropriate).
 - a. 277/480 Volt, 3 phase, 4 wire. 1200 Volt L-N, L-G, N-G and 1800 Volt L-L
 - b. 120/208 Volt, 3 phase, 4 wire. 700 Volt L-N, N-G, 800 Volt L-G and 1200 Volt L-L

C. Critical Load Protection – Fixed Equipment:

1. For 120 volt, 1 phase, 3 wire, type 3, category A3 unit.
 - a. Surge current capacity (I_{N}): 15,000/30,000 amps per protection mode/phase
 - b. Mounting: External, NEMA 12 enclosure
 - c. Components: Nonmodular units composed of 20mm Metal Oxide Varistors (MOV). Series inductors, SAD, or selenium cells may be used in addition to MOVs.
 - d. Protection modes and UL 1449 clamping voltage: 475 Volt L-N, L-G, and N-G.

D. Receptacles:

1. For 120 volt, 1 phase, 3 wire, type 3, category A3 unit.
 - a. Surge current capacity (I_{N}): 12,000 amps per protection mode.
 - b. Components: 20mm MOV
 - c. Maximum Continuous Operating Voltage: 150 Volts
2. Refer to Specification Section 26 27 26 for additional receptacle construction information.

E. EMI/RFI Noise Rejection or Filtering:

1. Each unit shall include a UL1283 first order, high-frequency filter for noise filtering between 10 KHz and 100 MHz.

F. Indication:

1. Each unit shall include solid-state indicators with externally mounted LED visual status indicators that indicate on-line status of each protection mode of the unit.
2. Each unit shall include an audible alarm with silencing switch to indicate when protection has failed.
3. Provide each service entrance and critical load type unit(s) with a transient counter.
4. Each unit shall contain form "C" contacts for remote indication of an alarm status.

G. Fuses:

1. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit.
2. Fuses shall be rated 200, 000 AIC minimum interrupting capacity.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine equipment for size and type of surge protection device to be used to ensure physical compatibility.
- B. Inspect surge protection device for any signs of physical damage due to shipping or handling before installing surge protection device.

3.2 INSTALLATION

A. Mounting Location:

1. The unit shall be installed as close as practical to the panel secondary lugs in accordance with applicable national/Local Electrical Codes and the manufacturer's recommended installation instructions. Connect the unit to the panel using a conduit nipple. Flush mount the unit in the front of the switchboard. Mount unit directly across from the breaker or disconnect serving it.
2. If internal surge protection device is specified, device shall be installed in a barrier compartment isolated from other components.

B. Connections:

1. Contractor shall provide wire and circuit breakers sized per the approved manufacturer's requirements. Maximum lead length from protected bus to surge protection device shall be per manufacturer's requirements, but no greater than 5'-0".
2. The surge protection unit shall be isolatable from the electrical distribution system via 3 pole circuit breaker mounted in the switchboard/panelboard. Single phase 120 volt units shall be hardwired without a disconnecting means.
3. Neutral and ground shall not be bonded together at secondary panelboard locations.

C. Additional Locations: Critical Load Protection – Fixed Equipment (120 Vac):

1. Install an A3 hard-wired or plug-in surge protection device between each of the following equipment items and its power supply conductors.
 - a. Fire alarm master panel
 - b. Phone switch
 - c. Intercom master
 - d. Building management system master
 - e. Security system master
 - f. Telephone switch
 - g. TV head

D. General:

1. Check unit for proper operation of protection and indication under start-up.
2. Check unit to ensure all MOVs for each mode of protection are operational. Verify integral fuse links are operational and have not melted.
3. Surge suppression devices shall not be installed ahead of the main service disconnect(s).
4. Install fuses in all fuse holders and fused disconnects internal to the surge protection unit. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit. External fusing of the surge protection device is not allowed.
5. Coordinate location of surge protection device to allow adequate clearances for maintenance.

END OF SECTION 26 43 00

SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Exterior luminaires and accessories
- C. Lamps
- D. Ballasts
- E. Poles

1.2 REFERENCES

- A. ANSI C78.377-2008 – Specifications for the Chromaticity of Solid State Lighting Products
- B. ANSI C82.4 - High-Intensity Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)
- C. ANSI C82.6 - Ballasts for HID Lamps - Method Measurement
- D. ANSI C82.11 - High Frequency Fluorescent Lamp Ballasts
- E. ANSI C82.77-2002 – Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- F. IEEE C2 - National Electrical Safety Code
- G. NEMA LE 2 - H-I-D Lighting System Noise Criterion (LS-NC) Ratings
- H. UL 935 – Standard for Fluorescent Lamp Ballasts
- I. Project site classification as defined in IESNA RP-33

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.
- B. Submit product data sheets for luminaires, lamps, ballasts, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with fixtures listed in ascending order, and with each luminaire's associated lamp, ballast, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
- C. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
- D. Include outline drawings, support points, weights, and accessory information for each luminaire type.
- E. Submit utility rebate forms, where offered at project location, with rebate items completed.
- F. LED luminaire submittals shall include photometric report per IESNA LM-79-08 for the latest generation system being furnished, including independent testing laboratory name, report number, date, luminaire model number, input wattage, luminaire, and light source specifications. Manufacturer origin of LED chipset and driver shall be submitted.
- G. For all LED luminaires specified as dimmer controlled, submit dimmer device data that is approved by manufacturer of submitted luminaire and that Contractor proposes to furnish and install. Contractor is responsible for verifying that installed dimming controls are compatible with and approved by the luminaire manufacturer.

H. LEED Requirements:

1. Light Pollution Reduction:

- a. Exterior Luminaires: Submit manufacturer data showing percentage of light lumens emitted at or above 90° from nadir for each luminaire type.

2. Toxic Material Reduction:

- a. Submit manufacturer published data for each lamp type being furnished, indicating mercury content in milligrams per lamp.

1.4 EXTRA STOCK

- A. Provide extra stock under provisions of Section 26 05 00.

- B. Other Lamps: 10 percent of quantity installed. Minimum of two (2) of each size and type, and maximum of one (1) case (20 lamps).

- C. Ballasts and LED Drivers: Five percent of quantity installed, minimum of one (1) of each size and type.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of Section 26 05 00.

- B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.

- C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.6 MOCKUP

- A. Provide and install luminaires with power and control connections in mockup rooms as identified in Division 1. Approved luminaires in mockup may be reused as part of complete work if in original condition.

1.7 WARRANTY

- A. Light emitting diode (LED) light engines and drivers shall have a ten-year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Lensed Troffers: Provide hinged frames with latches and 0.125 inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.

- B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.

- C. Parabolic Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction. Provide ballast covers to separate inboard/outboard lamps when multi-level switching is indicated, so light does not spill into unlit cells.

- D. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified.

-
- E. Exit Signs: Stencil face, 6 inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings.
 - F. Self-Powered Exit Signs: Stencil face, 6 inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings. One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - G. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - H. Painted reflector surfaces shall have a minimum reflectance of 90%.
 - I. All painted components shall be painted after fabrication.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Listed for wet or damp location as scheduled. Fountain and pool luminaires shall be listed for submersible location to meet depth specified.
- B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.
- C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F. Compartment separation of wire entry and control gear/lamp chamber.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

- A. Light emitting diodes used in interior applications shall have a minimum color rendering index (CRI) of 80. Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 70. Color temperature of the luminaires shall be as noted on the luminaire schedule.
- B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.
- C. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.
- D. LED Driver:
 - 1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Surge suppression device for all exterior luminaires.
 - 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type.
 - 3. Driver shall have a minimum of 50,000 hours rated life.

2.4 ACCEPTABLE MANUFACTURERS - POLES

- A. Manufacturer of Luminaire.
- B. Valmont Poles.
- C. U. S. Pole Company.
- D. KW Industries

2.5 LIGHTING POLES

- A. Metal Poles: Square straight steel anchor base.
- B. Laminated Wood Poles: Raceway type lighting pole; pressure treat with alkaline copper quaternary preservative.
- C. Wind Load: 100 MPH velocity, with 1.3 gust factor with luminaires and brackets mounted.
- D. Hand Hole: 2 x 4 inches with removable weatherproof cover installed at manufacturer's standard location. Provide matching gasketed cover plate.
- E. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Grout between anchor plate and concrete base with non-shrink grout after pole is plumbed.
- F. Vibration Damper: Canister or snake type second mode vibration damper internal to the pole as recommended by pole manufacturer. Provide additional pole top damper for first mode vibration on single-head poles where recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. If ceiling framing is not listed for luminaire size or weight, support luminaires independent of ceiling grid with a minimum of two (2) #12 gauge wires located on diagonal corners.
- B. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Support luminaires independent of ceiling with a minimum of two (2) #12 gauge wires located on diagonal corners.
- C. Support surface-mounted luminaires directly from building structure. Install luminaires larger than eight square feet (8 ft²) or weighing more than 30 pounds independent of ceiling framing.
- D. Support suspended or pendant mounted luminaires independent of ceiling grid with a minimum of two #12 gauge wires. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.
- E. Install lamps in lamp holders of luminaires.
- F. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.
- G. Parabolic louvers and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.
- H. Industrial Pendant Luminaires: Use hangers rated 500 pounds minimum or provide safety chain between ballast and structure. Provide safety chain between reflector and ballast.
- I. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.
- J. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 RELAMPING

- A. Replace failed lamps at completion of work. Replacement of LED lamp burnouts during the warranty period shall be the responsibility of the contractor, including ordering, installing, disposal, and manufacturer warranty claim processing.

3.3 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.

3.4 LUMINAIRE SCHEDULE

- A. As shown on the drawings.

END OF SECTION 26 51 00

SECTION 27 05 00 - BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.

1.2 SCOPE OF WORK

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Communications Systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the Communications Systems a finished and working system.
- C. Description of Systems include but are not limited to the following:
 - 1. Complete Structured Cabling System including, but not limited to:
 - a. Voice and data backbone cabling and terminations.
 - b. Voice and data horizontal cabling and terminations.
 - c. Information outlets (IO's) including faceplates, jacks and labeling.
 - d. Equipment racks, cabinets, cable management and equipment.
 - e. Telecommunication Room equipment including patch panels, optical distribution cabinets, and termination blocks.
 - f. Cabling pathways.
 - g. Grounding and Bonding
 - h. Testing
 - 2. Complete Audio/Visual Systems.
 - 3. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.
 - 4. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
 - 5. Firestopping of penetrations as described in Section 27 05 03.

1.3 OWNER FURNISHED PRODUCTS

- A. Network electronics, wireless access points and cross connects.

1.4 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.

B. Definitions:

1. "Electrical Contractor" as referred to herein refer to the Contractors listed in Division 26 of this Specification.
2. "Electrical Contractor" shall also refer to the Contractor listed in Division 27 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
3. "Communications Contractor" as referred to herein refer to the Contractors listed in Division 27 of this Specification.
4. Low Voltage Communications Wiring: The wiring (less than 120VAC) associated with the Communications Systems, used for analog and/or digital signals between equipment.
5. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications information outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling the bottom of the exposed structural joists the nearest cable tray.

C. General:

1. The purpose of these Specifications is to outline typical Electrical and Communications Contractor's work responsibilities as related to Communications Systems including Telecommunications rough-in, conduit, cable tray, power wiring and Low Voltage Communications Wiring. The prime contractor is responsible for all divisions of work.
2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Communications Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Communications Drawings but required for the successful operation of the systems shall be the responsibility of the Communications Contractor and included in the Contractor's bid.
3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Communications systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Communications Contractor has convened to determine the exact location and requirements of the installation.
4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Communications Wiring, the installation shall not begin until the Communications Contractor has completed a coordination review of the cable tray shop drawing.
5. This Contractor shall establish Electrical and Communications utility elevations prior to fabrication and installation. The Communications Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Electrical Busduct
 - e. Cable Trays, including 12" access space
 - f. Sprinkler Piping and other Piping

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- g. Conduit and Wireway
 - h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
2. Assumes all responsibility for providing and installing cable tray.
3. Responsible for Communications Systems grounding and bonding.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Communications Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Communications Wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined in here-in).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Communications equipment which is required to be bonded to the Communications ground system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.5 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

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- d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.
- B. Participation:
1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.
- C. Drawing Requirements:
1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
 2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
 4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.6 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:
 - a. TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces.
 - b. TIA/EIA 606 – Administration Standards for the Telecommunications Infrastructure of Commercial Buildings.
 - c. TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
 - d. ANSI/NECA 568 – Standard for Installing Commercial Building Telecommunications Cabling.
 - e. TIA/EIA 568-B – Commercial Building Telecommunications Cabling Standard
 - 1) B.1 – Part 1: General Requirements
 - 2) B.1-1 – Addendum 1: Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend Radius.
 - 3) B.2 – Part 2: Balanced Twisted Pair Cabling Components.
 - 4) B.2-1-2002– Addendum 1: Transmission Performance Specifications for 4-Pair 100 Ohm Category 6 Cabling.
 - f. UL 444 – Standard for Safety for Communications Cable.
 - g. NFPA 70 (NEC) – National Electrical Code.

B. Refer to individual sections for additional Quality Assurance requirements.

C. Qualifications:

1. Only products of reputable manufacturers as determined by the Engineer will be acceptable.
2. The installing Contractor shall be certified by the manufacturer of the structured cabling system. Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding this project. Documentation of certification is required at the time of bid. Shop drawings will not be approved until proof of certification is submitted. Refer to the end of this specification section for certification documentation requirements.
3. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the termination of cabling shall be individually certified by the manufacturer.
4. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
5. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and copper structured cabling systems and have personnel adequately trained in the use of such tools and equipment.

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6. The Contractor shall have certified BICSI installation technicians on staff to perform the following tasks on the project:
 - a. Act as the field superintendent or job foreman with the responsibility of monitoring the daily work of each technician.
 - b. Oversee all testing and termination of cabling.
 7. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
 - a. Documentation of certification of This Contractor by the proposed structured cabling system manufacturer as required at the end of this specification section.
 - b. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
 - c. A list of test equipment proposed for use in verifying the installed integrity of copper and fiber optic systems on the project.
 - d. A technical resume of experience for the Contractor's project manager and on-site installation supervisor assigned to this project.
 - e. Resume and certification of the BICSI installation technician for the project.
- D. Compliance with Codes, Laws, Ordinances:
1. This Contractor shall conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.
 2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
 3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.
 4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.
 5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
- E. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
 2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
 3. Pay all applicable charges for such permits or licenses that may be required.
 4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.

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6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.
 7. Pay any charges by the service provider related to the service or change in service to the project.
 8. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):
 - a. Factory Mutual
 - b. Underwriters' Laboratories, Inc.
- F. Examination of Drawings:
1. The drawings for the Communications Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
 2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
 3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
 4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
 5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
 6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.
- G. Electronic Media/Files:
1. Construction drawings for this project have been prepared utilizing Revit MEP.
 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.
 4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
 5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
 6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
 7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.

8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

H. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.
2. Field conditions that will result in telecommunications drops that exceed the length limitations identified in the contract documents shall be brought to the attention of the Engineer prior to installation. The cost of reworking cabling that is too long, that was not brought to the written attention of the Engineer will be borne entirely by the Contractor.
3. This Contractor shall provide the Engineer with written documentation of any cabling drops that will not be able to use the cable tray (where cable tray is available) due to the resulting cabling lengths. This documentation shall be submitted prior to installation and installation shall not commence until approved by the Engineer.

1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
27 05 26	Communications Bonding
27 05 28	Interior Communications Pathways
27 05 53	Identification and Administration
27 11 00	Communication Equipment Rooms
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing
27 41 00	Professional Audio/Video System

- B. In addition to the provisions of Division 1, the following is required:

1. Submittals shall include all layout drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
2. The Contractor shall submit an electronic copy of each shop drawing for review by the Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.
3. Shop drawings which are larger than 11" x 17" or are plan size layout drawings such as wiring diagrams and cable tray drawings, shall be submitted on reproducible media. Submit one reproducible and one print of each drawing or plan. All Contractor approval stamps shall be made on the reproducible. The Architect/Engineer will return the reproducible copy of the shop drawings, complete with comments. This Contractor shall copy and distribute these reviewed shop drawings as required. All costs for copying and distribution of reproducible shop drawings shall be included by This Contractor in their bid.

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4. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. CONTRACTOR'S APPROVAL STAMP IS REQUIRED ON ALL SUBMITTALS. APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all deviations from the contract documents on all submittals. IF DEVIATIONS ARE NOT MARKED BY THE CONTRACTOR, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND SPECIFICATION REQUIREMENTS.
 5. The Contractor shall provide RCDD stamp on the submittal.
 6. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 7. The Contractor shall clearly indicate the size, finish, material, etc.
 8. All submittals shall be assembled in sets by system.
 9. Each set shall be bound in a manufacturer's folder or inside of a manila file folder.
 10. Each set shall contain an index of the items enclosed with a general topic description on the cover.
 11. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is relevant to the work.
 12. Failure to comply with the above shall be reason to resubmit all shop drawing submittals.
 13. The Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and handle the additional shop drawing submittals.
 14. Provide documentation of all warranties required by the contract documents.
 15. Submit copy of the Contractor certification form contained at the end of specification section.
- C. Provide Schedule of Values for Technology Work:
1. Application forms: Use AIA Document Continuation Sheets G703 (or similar) as the form for application.
 2. Provide line items on the Schedule of Values including:
 - a. Structured Cabling
 - b. Overhead Paging/Intercom Systems
 - c. Audio/Video Systems
 3. Change orders shall have schedule of values broken out as listed above submitted with each change order.
 4. Coordinate with the Project Engineer the items included in the Schedule of Values. The intent is to not create schedules in addition to those the Technology Contractor normally submits to the General Contractor for payment.

1.8 EQUIPMENT SUPPLIERS' INSPECTION

A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:

1. Firestopping, including mechanical firestop systems.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

B. Store materials on the site so as to prevent damage.

C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.10 WARRANTY

A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.

B. Provide a structured cabling System Assurance Warranty as described herein.

C. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.

D. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.11 INSURANCE

A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.12 MATERIAL

A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Engineer shall make the final determination of whether a product is equivalent.

C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured **in writing** from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturer's equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.

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- D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 REFER TO INDIVIDUAL SECTIONS

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

- A. General:
1. Refer to specific Division 27 sections for further requirements.
 2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
 3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.

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4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.
 5. All telecommunications tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Overspray of paint on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Final Jobsite Observation:
 1. The Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
 2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
 3. The Contractor shall sign this form and return it to the Engineer so that the final observation can commence.
- C. Before final payment will be authorized, this Contractor must have completed the following:
 1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
 2. Submitted bound copies of approved shop drawings.
 3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.

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4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
 5. Submitted testing reports for all systems requiring final testing as described herein.
 6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
 7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final payment being approved.
 8. Provide System Assurance Warranty certificate for the telecommunications system.

3.5 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Submit three (3) properly indexed and bound copies, in "D" ring style notebooks, of the Operations and Maintenance Instructions to the Architect/Engineer for approval. Make all corrections or additions required.
- B. Operation and Maintenance Instructions shall include:
 1. Notebooks shall be heavy duty locking three ring binders and incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. Provide "Wilson-Jones" or equal, color black. Size notebooks a minimum of 1/2" thicker than material for future inserts. Label the spine and front cover of each notebook. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other forms of binding will be acceptable.
 2. Prepare binder covers (front and spine) with printed title "Operation and Maintenance Instructions", title of project, and subject matter of binder when multiple binders are required.
 3. Title page with project title, Architect, Engineer, Contractor, and Subcontractor with addresses, telephone numbers, and contacts.
 4. Table of Contents describing all index tabs.
 5. Listing of all Subcontractors and major equipment suppliers with addresses, telephone numbers, and contacts.
 6. Index tabs dividing information by specification section, major equipment, or systems. All tab titles shall be clearly printed under reinforced plastic tags.
 7. Copies of warranties.
 8. Copies of all final approved shop drawings and submittals.
 9. Copies of all factory inspection and/or equipment start-up reports.
 10. Schematic wiring diagrams of the equipment which have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 11. Dimensional drawings of equipment.
 12. Detailed parts list with list of suppliers.
 13. Operating procedures for each system.

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14. Maintenance schedule and procedures. Include maintenance chart that lists routine maintenance requirements and frequency over one-year time period.
 15. Repair procedures for major components.
 16. Replacement parts and service material requirements for each system and the frequency of service required.
 17. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.
- E. Refer to the individual specification sections for minimum hours of instruction time for each system.
- F. Operating Instructions:
 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the Communications Systems.
 2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Engineer to perform these services.

3.7 SYSTEM COMMISSIONING

- A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
- C. This Contractor shall maintain at the job site, a separate and complete set of Communications Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Communications Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.
- E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

END OF SECTION 27 05 00

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

In order to assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 75% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 25% of testing has been completed.
6. Telecommunications labeling has been provided on at least 25% of each type of component requiring a label.
7. All telecommunications related grounding is complete.
8. All Audio/Visual components, cabling and control systems are installed, programmed and operational.
9. All CCTV camera rough-ins are installed.
10. All access control system rough-ins are installed.

The project will be ready for final jobsite observation prior to the requested date of the observation, according to the above list of requirement.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

Telecommunications – Proof of Certification

There are specific Contractor qualification requirements for this project as defined in specification section 27 05 00, which may include Manufacturer Certification. This Proof of Certification document and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

Statement of Compliance:

The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer _____. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of _____, 20____.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: _____

Authorized Representative: (print) _____

Date: _____ Manufacturer Certification Number (if any): _____

Submit the following with the bid:

- This form.
- Proof of Manufacturer Certification indicated above.

SECTION 27 05 26 - COMMUNICATIONS BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Bonding Conductors
- B. Bonding Connectors
- C. Grounding Busbar (TMGB and TGB)
- D. Rack-mount Telecommunications Grounding Busbar

1.2 REFERENCES

- A. ANSI/IEEE 1100 – Recommended Practice for Power and Grounding Sensitive Electronic Equipment in Industrial and Commercial Power Systems
- B. ANSI/TIA/EIA 568-B.1-B.3 – Commercial Building Telecommunications Cabling Standard
- C. ANSI/TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces
- D. ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- E. ANSI/TIA/EIA 758 – Customer Owned Outside Plant
- F. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
- G. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- H. IEEE 837 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
- I. NFPA 70 – National Electrical Code
- J. NFPA 780 – Standard for the Installation of Lightning Protection Systems
- K. UL 96 – Lightning Protection Components
- L. UL 96A – Installation Requirements for Lightning Protection Systems
- M. UL 467 – Grounding and Bonding Equipment

1.3 RELATED SECTIONS

- A. Section 26 05 33 – Conduit
- B. Section 26 05 36 – Cable Trays
- C. Section 26 05 13 – Wire and Cable
- D. Section 26 05 26 – Grounding and Bonding
- E. Section 26 41 00 – Lightning Protection Systems
- F. Section 27 05 00 – Basic Communications Systems Requirements
- G. Section 27 11 00 – Communication Equipment Rooms
- H. Section 27 05 28 – Interior Communication Pathways
- I. Section 27 05 53 – Identification and Administration

1.4 SYSTEM DESCRIPTION

- A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.
- B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.
- C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.
- D. Basic System Requirements:
 - 1. A complete communications bonding infrastructure is required for this project. Refer to the drawings and the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.
 - 2. The bonding system shall include, but not be limited to, the following major components:
 - a. Bonding Conductor for Telecommunications (BCT)
 - b. Telecommunications Main Grounding Busbar (TMGB)
 - c. Telecommunications Bonding Backbone (TBB)
 - d. Telecommunications Grounding Busbar(s) (TGB)
 - e. Rack mount Telecommunications Grounding Busbar(s)
 - f. Bonding Conductor(s) (BC)
 - g. Bonding Connectors
 - h. Bonding system labeling and administration as defined in Section 27 05 53.

1.5 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.
- B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a minimum of five (5) years documented experience in the manufacture of communications bonding products.
- C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

1.6 SUBMITTALS

- A. Submit product data and shop drawings under provisions of Section 27 05 00 and Division 1.
- B. Provide manufacturer's technical product specification sheet for each individual component type. Submitted data shall show the following:
 - 1. Compliance with each requirement of these documents. The submittal shall acknowledge each requirement of this section, item-by-item, including construction, materials, ratings, and all other parameters identified in Part 2 - Products.

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2. Manufacturer's installation instructions indicating application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- C. Provide CAD-generated, project-specific system shop drawings as follows:
 1. Provide a system block diagram indicating system configuration, system components, interconnection between components, and conductor routing. The diagram shall clearly indicate all wiring and connections required in the system. When multiple devices or pieces of equipment are required in the exact same configuration (e.g., multiple identical equipment racks or sections of ladder tray), the diagram may show one device and refer to the others as "typical" of the device shown. The diagram shall list room numbers where system equipment will be located.
 2. Installation details for all system components.
 - D. Provide system checkout test procedure to be performed at acceptance.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under the provisions of Section 27 05 00.
- B. Store and protect products under the provisions of Section 27 05 00.
- C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 27 05 00.
- B. Provide final system block diagram showing any deviations from approved shop drawing submittal.
- C. Provide floor plans that document the following:
 1. Actual locations of system components, devices, and equipment.
 2. Actual conductor routing.
 3. Actual system component, device, equipment, and conductor labels.
- D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.
- E. Complete all operation and maintenance manuals as described below.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 27 05 00.
- B. Submitted data shall include:
 1. Approved shop drawings.
 2. Descriptions of recommended system maintenance procedures, including:
 - a. Inspection
 - b. Periodic preventive maintenance
 - c. Fault diagnosis
 - d. Repair or replacement of defective components

PART 2 - PRODUCTS

2.1 BONDING CONDUCTORS

A. Bare Copper:

1. Annealed uncoated stranded conductor.
2. Minimum size 6 AWG.

B. Insulated Copper:

1. Annealed uncoated stranded conductor.
2. Insulation:
 - a. PVC insulation with nylon outer jacket.
 - b. Rated \geq 600 volts.
 - c. Green.
3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing

1. All Communications bonding system conductors shall be sized by length as follows:

Length Linear ft (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
Greater than 66 (20)	3/0

2. The BCT shall be the same size as the TBB or larger.

2.2 BONDING CONNECTORS

A. Acceptable Types:

1. Two-hole compression lug
2. Exothermic weld
3. Irreversible compression

B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.

C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (TMGB AND TGB)

A. Features:

1. Wall-mount configuration.
2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-A standards.
4. Predrilled holes.
5. Integral insulators.
6. Stainless steel offset mounting brackets.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar.
2. Minimum Dimensions: 1/4" thick x 4" high x 12" long.
 - a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.
3. Hole pattern shall include:
 - a. A minimum of 15 sets of 5/16" holes, 5/8" on center, to accommodate "A" spaced 2-hole compression lugs.
 - b. A minimum of three (3) sets of 7/16" holes, 1" on center, to accommodate "C" spaced 2-hole compression lugs.

2.4 RACK-MOUNT TELECOMMUNICATIONS GROUNDING BUSBAR

A. Features:

1. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
2. Predrilled holes.
3. Mounts in a standard 19" equipment rack.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar.
2. Minimum Dimensions: 3/16" thick x 3/4" high x 19" long.
 - a. Increase dimensions and/or quantity furnished and installed as required to accommodate all terminations required by the project, plus 20% spare capacity.
3. Hole pattern shall include:
 - a. A minimum of eight (8) 6-32 tapped lug mounting holes on 1" centers.
 - b. A minimum of two (2) pairs of 5/16" diameter holes spaced 3/4" apart.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Bonding Requirements:

1. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.
2. A licensed electrician shall perform all bonding.
3. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Main Cross Connect and Service Entrance Room Bonding Requirements:

1. Locate the TMGB in the service entrance room unless otherwise noted on the drawings.
2. The location of the TMGB shall be the shortest practical distance from the telecommunications primary lightning protection devices.
3. Bond the telecommunications primary protectors to the TMGB. Maintain a minimum 1 foot (300 mm) separation of the bonding conductor from all DC power cables, switchboard cable, and high frequency cable.

C. Telecommunications Main Ground Bar (TMGB) Requirements:

1. Install TMGB such that it is insulated from its support with a minimum 2" standoff.
2. Bond the TMGB to the electrical service ground via the BCT.
 - a. A minimum of 1 foot (300 mm) separation shall be maintained between the BCT and any DC power cables, switchboard cable, or high frequency cables.
3. Where backbone or horizontal cabling contains a shield, the shield(s) shall be bonded to the TMGB.
4. TMGB shall be bonded to all electrical panels located in the same room or space as the TMGB or in an immediately adjacent space within 20 linear feet of the TMGB. TMGB shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the TMGB.
5. TMGB shall be bonded to accessible metallic building structure located within the same room or space as the TMGB.
6. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the TMGB, shall be bonded to the TMGB.
7. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the TMGB, shall be bonded to the TMGB.

D. Telecommunications Ground Bar (TGB) Requirements:

1. Provide a TGB in each telecommunications equipment room.
2. Install TGB such that it is insulated from its support with a minimum 2" standoff.
3. Bond each TGB to the TMGB via the TBB.
 - a. A minimum of 1 foot (300 mm) separation shall be maintained between the TBB and any DC power cables, switchboard cable, or high frequency cables.
 - b. The TBB may be routed from TGB to TGB or as a radial feed to each TGB as the layout requires.
4. When there are multiple telecommunications equipment rooms on each floor in buildings containing more than five stories, the TGBs on the same floor shall be bonded together horizontally using a grounding equalizer (GE) on the first, last, and every third intermediate floor. GE conductors shall be the same size as the TBB.
5. If more than one (1) TGB is provided within the same room or space, they shall all be bonded together via a BC the same size as the TBB.
6. Where horizontal cabling contains a shield, the shield(s) shall be bonded to the TGB.
7. TGBs shall be bonded to accessible metallic building structure located within the same room or space as the TGBs.
8. TGBs shall be bonded to all electrical panels located in the same room or space as the TGB or in an immediately adjacent space within 20 linear feet of the TGB. TGBs shall be bonded to all electrical panels providing electrical power to communications equipment located in the same room or space as the TGB.
9. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the TGB, shall be bonded to the TGB.
10. All metallic communications equipment, including, but not limited to, cable pair protectors, surge suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the same room or space as the TGB, shall be bonded to the TGB.

E. Rack-mount Telecommunications Ground Bar Requirements (RTGB):

1. Provide a rack-mount telecommunications ground bar in each equipment rack and equipment rack enclosure.
2. Install RTGB such that it is electrically bonded to the rack. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond between RTGB and equipment rack.
3. Bond each RTGB to the TGB via a BC.
4. If more than one (1) RTGB is provided within the same room or space, they shall all be bonded together via a BC.
5. Where horizontal cabling containing a shield is terminated on rack-mounted termination hardware, the shield(s) shall be bonded to the RTGB.

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6. All contractor-furnished and/or contractor-installed metallic communications equipment, including, but not limited to patch panels, fiber optic distribution enclosures, splice enclosures, active electronics, uninterruptible power supplies, etc., mounted within the same equipment rack as the RTGB, shall be bonded to the RTGB. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond between equipment rack and installed metallic communications equipment. Active electronics and uninterruptible power supplies shall be bonded to the RTGB via a dedicated BC for each device.
- F. Metallic Interior Communication Pathway Bonding Requirements:
1. All metallic interior continuous communication cable pathways, including, but not limited to, conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder rack, shall be bonded to the communications bonding system.
- G. Bonding Conductor Requirements:
1. Bonding conductors shall be green or marked with a distinctive green color.
 2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest and straightest paths possible. Number of bends and changes in direction should be minimized. Install and secure conductors in a manner that protects the conductors from impact and from physical or mechanical strain or damage.
 3. Bonding conductors shall not be installed in metallic conduit.
 4. All conductors, including, but not limited, to the BCT, TBB, and BC(s), shall be installed splice-free. If the Contractor believes that site conditions do not allow a splice-free installation, the Contractor may request permission from the Engineer to splice a specific communications bonding system conductor.
 - a. Where documented permission to splice a conductor is granted:
 - 1) The number of splices shall be limited to as few as possible.
 - 2) Splices shall be made using exothermic welding or irreversible compression-type connections only. Splice hardware shall be listed for grounding and bonding. Solder is not an acceptable means of splicing conductors.
 - 3) Splices shall be made in telecommunications spaces in accessible locations to facilitate future inspection and maintenance.
 - 4) Splices shall be adequately supported and protected from impact and from physical or mechanical strain or damage.
 5. All bonding conductors shall be labeled in accordance with the requirements of Section 27 05 53. In addition to the requirements of Section 27 05 53:
 - a. Labels shall be nonmetallic.
 - b. Labels shall be printer-generated.
 - c. Labels shall be located on conductors as close as is practical to their point of termination in a readable position.
 - d. Additionally, conductors shall be labeled as follows:
 - 1) "IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER."

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6. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.
 7. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors.
- H. Bonding Connection Requirements:
1. Make all connections in accessible locations to facilitate future inspection and maintenance.
 2. Communications bonding system connections shall be made using exothermic welding, two-hole compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is prohibited, except for connections to a rack-mount telecommunications ground bar. Connection hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to make communications bonding system connections.
 3. Thoroughly clean conductors before installing lugs and connectors.
 4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose. Exercise care not to tighten connectors beyond manufacturer's recommendations.
 5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond at all connections.
 6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in accordance with manufacturer's recommendations and instructions.
 7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector and be installed in accordance with manufacturer's recommendations and instructions.

3.2 FIELD QUALITY CONTROL

- A. Field testing shall be performed under provisions of Section 27 05 00.
- B. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product from a reputable manufacturer that meets the requirements of the specifications.
- C. Periodic observations will be performed during construction to verify compliance with the requirements of the specifications. These services do not relieve the Contractor of responsibility for compliance with the contract documents.

3.3 ADJUSTING

- A. Adjust work under provisions of Section 27 05 00.
- B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Owner.

3.4 TESTING

- A. Test installed system under provisions of Section 27 17 10.

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- B. Measure and document resistance to ground at TMGB, each TGB, each RTGB, and each electrical distribution panel bonded to the TMGB or a TGB.
 - 1. Measurements shall be made not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
 - 2. Measured resistance to ground at TMGB, each TGB, and each RTGB must not exceed 5 ohms.
 - 3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.
 - C. Include measurement documentation in test data submitted at completion of project under provisions of Section 27 17 10.

3.5 SYSTEM TRAINING

- A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at the project site using the project equipment.
 - 1. Provide two week's advanced notice of training to the Owner and Engineer.
 - 2. The Engineer shall be presented with the option to attend the training.
 - 3. Provide a training outline agenda describing the subject matter and the recommended audience for each topic.
- B. At a minimum, the following training shall be conducted:
 - 1. A course detailing the system functions and operations that a technical user will encounter. Provide training on all aspects of using the system, including making new bonding connections to the TMGB, TGB, or RTGB. Provide training on all recommended inspection, maintenance, and repair procedures for the system.
- C. Minimum on-site training times shall be:
 - 1. Technical user: Four hours.

END OF SECTION 27 05 26

SECTION 27 05 28 - INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire mesh support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant as shown on the drawings.
- B. Wire mesh support systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

1.2 RELATED SECTIONS

- A. Section 26 05 33 - Conduit
- B. Section 27 05 00 - Basic Communications Systems Requirements
- C. Section 27 05 26 - Communications Bonding

1.3 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NEMA VE 2-2000 - Cable Tray Installation Guidelines

1.4 DRAWINGS

- A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

1.5 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.
- B. Coordination Drawings:
 - 1. Include cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.6 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for requirements.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Refer to Section 26 05 33 for conduit requirements for this project.

2.2 WIRE MESH CABLE TRAY – OVERHEAD AND UNDERFLOOR

- A. Acceptable Manufacturers:
1. Cooper B-Line "Flextray"
 2. Cablofil, Inc.
 3. Wiremold "Fieldmate"
- B. General: Provide wire mesh of types and sizes indicated on drawings; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Provide drop-out fittings where cable tray is installed over equipment racks. Two drop-out fittings shall be installed over each rack so that a controlled radius is maintained into each side of every equipment rack that cable tray passes over. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.
- C. Wire mesh shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh pattern with intersecting wires welded together. All wire ends along wire mesh sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
- D. Materials and Finishes: Material and finish specifications for each wire mesh type are as follows:
1. Electro-Galvanized Zinc: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM B633 SC2. Additionally, straight sections shall be painted Flat Black.
 2. Accessories:
 - a. Pre-Galvanized Zinc: Wall brackets and other pre-galvanized accessories shall be coated with zinc in accordance with ASTM A653.
 - b. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be coated in accordance with ASTM B633 SC3. All threaded components shall be coated in accordance with ASTM B633 SC1.
 - c. Underfloor cable tray shall be provided with bend radius control fittings at all inside corners.
- E. Type of Overhead Wire mesh Support System:
1. All straight section longitudinal wires shall be straight (with no bends).
 2. Wire mesh supports shall be trapeze hangers or wall brackets. Center hung supports will not be allowed.
 3. Trapeze hangers are to be supported by 1/4 inch or 3/8 inch diameter rods.
 4. Provide manufacturer approved grounding clips as necessary for continuous grounding of tray.

2.3 CABLE HANGERS AND SUPPORTS

- A. Provide a non-continuous cable support system suitable for use with open cable.
- B. Cable Hooks:
1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.

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2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.
 3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use.
- C. Cable Hangers:
1. Adjustable, non-continuous cable support slings for use with low voltage cabling.
 2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.
 3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.
 4. Cabling hanger load limit shall be 100 lbs per foot.
 5. Manufacturer: Erico Caddy, CableCat CAT425, Arlington Fittings TI Series or approved equal.

PART 3 - EXECUTION

3.1 CABLE HOOK SUPPORT SYSTEM

- A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.
- B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.
- C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".
- D. Cable hooks shall be selected based on the contractors cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.
- E. Support spans shall be based on the manufacturer's load ratings. In no case shall a 5 foot span be exceeded.
- F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.
- G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.2 CONDUIT AND CABLE ROUTING

- A. Refer to specification section 26 05 03 for additional requirements.
- B. All conduits shall be reamed and shall be installed with a nylon bushing.
- C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.
- D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.

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- E. Any conduit exceeding 90' in length or containing more than three (3) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.
 - 1. A separate pull box is required for each 90' (or greater) length section.
 - 2. A separate pull box is required after any three (3) consecutive 90-degree bends.
 - 3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.
 - F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.
 - G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.3 WIRE MESH TRAY INSTALLATION

- A. The wire mesh cable tray system shall be only for telecommunications.
- B. Install wire mesh as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
- C. Cable tray sections shall be grounded in accordance with manufacturer's recommendations using manufacturer approved hardware. Painted sections shall have paint removed at each grounding attachment point.
- D. Test wire mesh support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Refer to NFPA 70B, Chapter 18, for testing and test methods.
- E. Provide sufficient space encompassing wire mesh to permit access for installing and maintaining cables.
- F. Tray shall be continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without 2" x 4" mesh support.
- G. Overhead and Underfloor Tray shall be field cut using only manufacturer approved cutting device and methods. Cutting device shall be an offset blade bolt cutter; standard bolt cutters are specifically not permitted. Drop-in tray sections shall not be field cut or field modified in any way.
- H. Bends in overhead and underfloor tray shall be accomplished by utilizing manufacturer's cutting guides.
- I. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

3.4 ATTACHMENT TO METAL DECKING

- A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center. This 25 lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION 27 05 28

SECTION 27 05 43 - EXTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing exterior conduits, sleeves, etc. for an exterior cabling plant.

1.2 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.
- B. Precast Manufacturer (if applicable): Company specializing in precast concrete structures with three (3) years documented experience.

1.3 REFERENCES

- A. Section 27 05 00 – Basic Communications Systems Requirements.
- B. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- C. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.
- D. ASTM A48 - Gray Iron Castings.
- E. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

1.4 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.
- B. Manhole submittal (if applicable): Indicate material specifications, dimensions, capacities, size and location of openings, reinforcing details, and accessory locations.
 - 1. Provide product data for manhole accessories.
- C. Submit shop drawings and product data under provisions of Section 27 05 00.
- D. Submit manufacturer's installation instructions under provisions of Section 27 05 00.
- E. Coordination Drawings:
 - 1. Include hand holes and conduits 1.5" and larger in coordination files. Include all in-floor and underfloor conduit in coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

1.5 REGULATORY REQUIREMENTS

- A. Equipment and material shall be UL (Underwriters Laboratory) listed and labeled.

PART 2 - PRODUCTS

2.1 OUTSIDE PLANT CONDUIT

A. Rigid Metallic Conduit (RMC) and Fittings:

1. Rigid steel conduit hot-dipped galvanized inside and out with threaded ends meeting ANSI C80.1.
2. Fittings and Conduit Bodies:
 - a. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
 - b. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
 - c. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
 - d. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not acceptable.**
 - e. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.
3. Acceptable Manufacturers:
 - a. Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or pre-approved equal.

B. Fittings:

1. Sweeps: Factory manufactured RMC wrapped with 4 mil vinyl tape with a bend radius as follows:
 - a. Conduit internal diameter of 2" or less is 6 times the internal conduit diameter.
 - b. Conduit internal diameter of more than 2" is 10 times the internal conduit diameter.
2. End Caps (Plugs): Pre-manufactured and watertight. Tape is not an acceptable end cap or cover.

2.2 HAND-HOLES

A. Type:

1. Polymer concrete

B. Dimensions:

1. As indicated on the drawings.

C. Requirements:

1. Includes polymer concrete cover cast iron cover steel checker plate covers.

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- D. Acceptable Manufacturers
 - 1. Quazite
 - 2. Old Castle Precast Christy®
 - 3. New Basis.

2.3 UNDERGROUND WARNING TAPE

- A. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, compounded for direct-burial service.
- B. Overall Thickness: 5 mils (0.125 mm).
- C. Foil Core Thickness: 0.35 mil (0.00889 mm).
- D. Orange colored tape 3-wide with 1-inch high black letters permanently imprinted with "CAUTION – BURIED COMMUNICATIONS LINE BELOW". Printing on tape shall be permanent and shall not be damaged by burial operations.
- E. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- F. Comply with ANSI Z535.1 through ANSI Z535.5.

PART 3 - EXECUTION

3.1 EXCAVATION, FILL, BACKFILL, COMPACTION

- A. General:
 - 1. The Contractor shall do all necessary excavating, securing, filling, backfilling, compacting, and restoration in connection with their work.
- B. Excavation:
 - 1. Excavations for trenches shall be excavated to proper dimensions to permit installation and inspection of work.
 - 2. Where excavations are carried in error below indicated levels, thoroughly compacted sand-gravel fill, shall be placed in such excess excavations.
 - 3. Excavations shall be protected against frost action and freezing.
 - 4. Care shall be exercised in excavating so as to not damage surrounding structures, equipment, and buried utilities. In no case shall any major structural footing or foundation be undermined.
 - 5. Excavation shall be performed in all ground characteristics, including rock, if encountered. Each bidder shall visit the premises and determine, by actual observations, borings, or other means, the nature of the soil conditions. The cost of all such inspections, borings, etc., shall be borne by the bidder.
 - 6. In the case where the trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.

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7. Where satisfactory bearing soil is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately and no further work shall be done until further instructions are given.
 8. Mechanical excavation of the trench to line and grade of the conduit, unless otherwise indicated on the drawings.
- C. Dewatering:
1. The Contractor shall be responsible for the furnishing, installation, operation and removal of all dewatering pumps and lines necessary to keep the excavation free of water at all times.
- D. Underground Obstructions:
1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811. The Contractor is responsible for obtaining all utility locates for all trades on the project to determine obstructions indicated. The Contractor shall use great care in installing in the vicinity of underground obstruction.
- E. Fill and Backfilling:
1. No rubbish or waste material shall be permitted in excavations for trench fill and backfill.
 2. The Contractor shall provide the necessary sand for backfilling.
 3. Dispose of the excess excavated earth as directed.
 4. Soils for backfill shall be suitable for required stability and compaction, clean and free from perishable materials, frozen earth, debris or earth with an exceptionally high void content, and free from stones greater than 4 inches in diameter. Under no circumstances shall water be permitted to rise in unbackfilled trenches after installation has been placed.
 5. All trenches shall be backfilled immediately after installation of conduit, unless other protection is directed.
 6. All conduit shall be laid on a compacted bed of sand at least 3" deep. Backfill around the conduit with sand, spread in 6" layers, then compact each layer.
 7. Use sand for backfill up to grade for all conduit located under building slabs or paved areas. All other conduit shall have sand backfill to 6" above the top of the conduit.
 8. The backfilling above the sand shall be placed in uniform layers not exceeding 6" in depth. Each layer shall be placed, then carefully and uniformly tamped, so as to eliminate the possibility of lateral or vertical displacement.
 9. Install a warning tape approximately 12 inches below finished grade over all underground duct banks. The identifying warning tape shall be as specified above.
 10. Where the fill and backfilling will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
 11. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

3.2 RESTORATION REQUIREMENTS

- A. Where soil and sod has been removed, it shall be replaced as soon as possible after backfilling is completed. All areas disturbed by work shall be restored to their original condition. The restoration shall include any necessary topsoiling, fertilizing, liming, seeding, or mulching,

END OF SECTION 27 05 43

SECTION 27 05 53 - IDENTIFICATION AND ADMINISTRATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the execution and administration requirements relating to the structured cabling system and its termination components and related subsystems.
- B. Identification and labeling.

1.2 RELATED SECTIONS

- A. Section 27 05 00 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

- A. Refer to section 27 05 00 for relevant standards.

1.4 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Documentation of labeling scheme.

PART 2 - PRODUCTS

2.1 LABELING

- A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.
- B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.
- C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface and attachment method.
- D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.
 - 1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum "quiet zone" of 0.25" on each side of the bar code.
 - 2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.
- E. Color Code: Observe the following requirements for color coding:
 - 1. Labels on each end of a cable shall be the same color for each termination.
 - 2. Labels for cross-connects shall be two different colors at each termination fields, representative of the color of that field.
 - 3. Orange (Pantone 15C) shall be used for the demarcation point.

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4. Green (Pantone 353C) shall be used for the termination point of network connection on the facility side of the demarc.
 5. Purple (Pantone 264C) shall be used to identify the termination of cables from common equipment (PBX, computers, LANS, etc.)
 6. White shall be used to identify the first-level backbone termination in the main cross-connect.
 7. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the telecommunications closet and/or equipment room end of the cable.
 8. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone cable terminations.
 9. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms, maintenance, security, etc.
 10. In facilities that do not contain a main cross-connect, the color white may be used to identify second-level backbone terminations.
- F. Tag all CAT 6, and optical fiber cables at both the Communications Equipment Room and the information outlets. Coordinate labeling scheme with City of Madison staff during Pre-installation meeting.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND LABELING

A. Cable Labeling: Backbone and horizontal cables shall be labeled at each end.

1. Provide additional cable labeling at each manhole and pull box.
2. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.
3. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.

B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

C. Termination Hardware Labeling:

1. An identifier shall be provided at each termination hardware location or its label.

D. Grounding/Bonding Labeling:

1. The TMGB shall be labeled "TMGB." There shall be only one TMGB in the facility.
2. Label all TBB conductors connecting to the TMGB with a unique label, located at both ends of the TBB.
3. Each TGB shall be labeled with a unique label.
4. All TBB conductors connecting to the TGB shall be labeled uniquely at each end of the cable.

END OF SECTION 27 05 53

SECTION 27 11 00 - COMMUNICATION EQUIPMENT ROOMS (CER)

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements related to furnishing and installing equipment for Communication Equipment Rooms. Communication Equipment Rooms include rooms for the Main Cross Connect (MC).
- B. Definitions:
 - 1. Main Cross Connect (MC): Allows single point administration of technology components for cross-connect of first level backbone cables, entrance cables and equipment cables.
- C. Refer to Specification Section 27 05 28 for cable pathway and support requirements.

1.2 RELATED SECTIONS

- A. Section 27 05 00 - Basic Communications Systems Requirements
- B. Section 27 05 26 - Communications Bonding
- C. Section 27 05 28 - Interior Communication Pathways
- D. Section 27 15 00 - Horizontal Cabling Requirements

1.3 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for applicable standards.

1.4 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.
- B. Coordination Drawings:
 - 1. Include ladder racking, equipment racks, cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 27 05 00 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT GROUNDING

- A. Refer to specification section 27 05 26 for grounding requirements.
- B. All equipment required to be grounded shall be provided with a grounding lug suitable for termination of the specified size electrode conductor.

2.2 EQUIPMENT RACKS

- A. Where identified on the drawings in Communication Equipment Rooms, equipment racks shall be furnished and installed by the Contractor to house cable termination components (e.g., copper, optical fiber, coax) and network electronics.
- B. The equipment rack shall conform to the following requirements:
 - 1. Standard TIA/EIA 19" Floor Rack:
 - a. Equipment rack shall be 84" in height, self-supporting and provide a useable mounting height of 45 rack units (RU) (1 RU = 1 ¾").
 - b. Channel uprights shall be spaced to accommodate industry standard 19" mounting.
 - c. Equipment rack shall be double side drilled and tapped to accept 12-24 screws. Uprights shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole pattern on rack front shall be per TIA/EIA specifications (5/8"-5/8"-1/2"). Hole pattern on the rear shall be at 3" intervals to accept cable brackets.
 - d. Equipment racks shall be provided with a supply of spare screws (minimum of 24).
 - e. Equipment racks shall be provided with a ground bar and #6 AWG ground lug.
 - f. Provide all mounting hardware and accessories as required for a complete installation.

2.3 CABLE MANAGEMENT – VERTICAL AND HORIZONTAL

- A. Equipment Racks:
 - 1. Equipment racks shall be equipped with vertical and horizontal cable management hardware in the form of rings and guides. Racks shall incorporate vertical and horizontal covers, to allow an orderly, hidden, routing of copper, optical fiber, and coax jumpers from the modular patch panels and/or 110-type termination blocks to the customer provided network electronics. Vertical and horizontal cable management hardware shall be as follows:
 - a. Horizontal cable management hardware shall be painted steel (3.5" panel), have a minimum of five (5) jumper distribution rings (1.75" x 3.75" minimum dimension) and incorporate jumper routing clips (plastic) for individual jumpers. Provide with cover designed to conceal and protect cable.
 - b. At a minimum, horizontal cable management hardware shall be positioned above and below (a) each grouping of two rows of jacks on modular patch panels, and (b) above and below each optical fiber patch panel and (c) each grouping of two rows of F-type connectors on coax patch panels.
 - c. Vertical cable management hardware shall provide for cable routing on front and rear of each rack and be 3½" square (minimum). Vertical cable management hardware shall mount on spacers attached to the rack uprights and not on the upright itself. Where multiple equipment racks are to be installed, this hardware shall be mounted between the uprights of adjacent equipment racks. Equipment rack uprights and the spacers shall be secured together per manufacturer's recommendations. Provide with cover designed to conceal and protect cable.
 - 2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., "hook and loop") cable support ties.

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3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or ladder rack system is NOT acceptable. The proposed method shall be included in the submittals required by this document and shall be approved by the Engineer prior to installation.

B. 110-type Termination Blocks:

1. Horizontal troughs incorporating plastic distribution rings shall be provided by the Contractor to accommodate routing of jumpers. Horizontal troughs shall be positioned at the top of each column of 110-type termination blocks and between each 100-pair 110-type termination block.
2. Vertical troughs incorporating metal distribution rings shall be provided for vertical routing of jumper and/or cross-connect wire.

2.4 PATCH PANELS

- A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be furnished and installed by the Contractor for termination of copper cable.
- B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels consisting of a modular connector system incorporating modular jacks meeting the specifications for the jacks detailed in Section 27 15 00.
- C. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-density modular patch panels will not be accepted.
- D. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.
- E. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius specifications are adhered to.

2.5 TERMINATION BLOCKS

- A. Where identified on the drawings in Communication Equipment Rooms, 110-type termination blocks shall be furnished and installed by the Contractor for termination of copper cable.
- B. Each horizontal row of the 110-type termination block must be capable of terminating one (1) 25-pair binder group (backbone cables). Backbone and horizontal 110-type termination blocks shall be segregated, clearly identifying their function.
- C. The Mechanical Termination Shall:
 1. Have the ability of terminating 22 - 26 AWG plastic insulated, solid and stranded copper conductors.
 2. Provide a direct connection between the cable and jumper wires.
 3. Have less than 0.2 dB of attenuation from 1-16 MHz.
 4. Have less than 100 mW of DC resistance.
 5. Have less than 5 mw of resistance imbalance.

-
- 6. Have minimal signal impairments at all frequencies up to 16 MHz.
 - D. The 110-type termination block shall identify pair position by a color designation - Blue, Orange, Green, Brown and Slate (backbone only).
 - E. The 110-type termination block shall be designed to maintain the cables' pair twists as closely as possible to the point of mechanical termination.

2.6 LADDER RACK

- A. Provide complete ladder rack system including metallic ladder rack, splice connectors, fastening hardware and other miscellaneous materials as required for a complete installation per manufacturer's recommendations.
- B. Steel C-Channel Stringer Style Ladder Rack:
 - 1. Rolled steel siderail stringer, 1-1/2" stringer height, 9" spaced welded rungs.
 - 2. Steel shall meet the requirements of ASTM A1011 SS Grade 33.
 - 3. Loading limits shall be 292 lbs/ft for 4 ft spans.
- C. Ladder rack finish shall be flat black powder coat.

2.7 D-RINGS

- A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.
- B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.
- C. Provide ¼" screw holes for wall mounting.

2.8 POWER STRIPS

- A. Provide power strips on all equipment racks, unless noted otherwise. These power strips shall have the following characteristics:
 - 1. Standard Rack Mount:
 - a. TIA/EIA 19" equipment rack mountable.
 - b. Compliant with UL-1283, UL-1449 Second Edition and UL-497A.
 - c. Provide transient suppression to 13,000-A. Protection shall be in all three modes (line-neutral, line-ground and neutral-ground).
 - d. Shall meet or exceed ANSI C62 Category A3 requirements.
 - e. Provide high-frequency noise suppression as follows:
 - >20-dB @ 50 kHz
 - >40-dB @ 150 kHz
 - >80-dB @ 1 MHz
 - >30-dB @ 6 to 1000 MHz
 - f. Provide a minimum of 320 joules of AC energy absorption.
 - g. Be equipped with a 12-foot power cord.

-
- h. Shall meet or exceed IEEE 587 Category A & B Specification.

PART 3 - EXECUTION

3.1 EQUIPMENT RACKS

- A. Equipment racks shall be furnished and installed as shown on the drawings.
- B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall be joined and the ground made common on each. The rack shall be stabilized by extending a brace to the wall. Alternately, overhead ladder rack by which the cabling accesses the equipment rack(s) may provide this function.
- C. A space between the rack upright and the wall (approximately 4") should be provided to allow for cabling in that area. The rear of the rack should be approximately 40" from the wall to allow for access by maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required. Locations where these guidelines cannot be followed should be brought to the attention of the Engineer for resolution prior to installation.
- D. All hardware and equipment is to be mounted between 18" and 79" above floor level. This is to afford easy access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware should be reviewed and approved by the Engineer and Site Coordinator(s) prior to installation.
- E. Equipment racks shall be equipped with cable management hardware as to allow an orderly and secure routing of copper cabling to the modular patch panels. Additional Jumper Management panels may be required pending installation of other cable types on the equipment rack.
- F. Each rack shall be grounded to the Telecommunications Ground Bar (GND) using a #6 AWG (or larger) insulated stranded copper conductor (GREEN jacket) directly or via an adjacent grounded equipment rack. Refer to grounding requirements below.

3.2 LADDER RACK

- A. Provide support for ladder rack on 4 ft centers.
- B. Maintain a 1.5 safety factor on all load limits specified herein.
- C. Ladder rack support shall be by 5/8" diameter threaded rod when ceiling mounted. Ladder rack requiring wall mounting shall utilize accessories supplied by the ladder rack manufacturer specifically for the purpose of wall mounting ladder rack.

3.3 D-RINGS

- A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall in an Equipment Room.
- B. Locate D-rings on 24" centers vertically and horizontally.
- C. Securely attach D-rings to the wall as required by the manufacturer.

3.4 GROUNDING

- A. Provide a complete grounding system in accordance with the requirements of Section 27 05 26.

3.5 CONDUITS AND CABLE ROUTING

- A. Refer to Section 26 05 33 for additional requirements.

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- B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown on the contract documents. Conduits entering the room from the floor shall extend 3" above the floor slab or 3" into the room below the raised floor.
 - C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to support the cabling from floor to ceiling level.
 - D. All conduits shall be reamed and shall be installed with a nylon bushing.
 - E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less, maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter greater than 2", maintain a bend radius of at least 10 times the internal diameter.

END OF SECTION 27 11 00

SECTION 27 15 00 - HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 RELATED SECTIONS

- A. Section 27 05 00 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.
- B. The channel shall be required to meet the performance requirements indicated herein. The manufacturer shall warranty the performance of their system to the required performance (and not just to the Standard, should the required performance exceed the Standard).
- C. Specific components of the channel shall be required, at a minimum, to meet the Standard component requirements for that particular component.
- D. The installing contractor must be certified by the manufacturer of the structured cabling system.

1.4 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE

- A. CAT 6 Plenum Cable:
 - 1. The horizontal cable requirements must be met as well as the following channel requirements.
 - 2. CAT 6 cable shall terminate on rack-mounted modular patch panels in their respective Communication Equipment Room as indicated on the drawings.
 - 3. Performance Tests shall be conducted at a discrete test frequency of 250 MHz for the channel. All numbers given are for a 4-connection channel.
 - 4. Performance data shall be provided by third party independent testing laboratories only. Testing data shall be submitted on the third party testing laboratory letterhead. Test data will only be accepted if it displays testing as a channel. Electrical characteristics of the performance of the cable itself will not satisfy this requirement.

5. The structured cabling and connectivity may be provided by the same company. Alternately, ally or partnerships between cabling manufacturers and connectivity manufacturers will be acceptable. Ad-hoc cabling solutions in which the cabling manufacturer does not have a relationship, agreement, or other means of support channel arranged with the connectivity manufacturer will not be accepted.

6. Channel Requirements:

Insertion Loss:	250 MHz	34.1 dB
NEXT:	250 MHz	36.1 dB
PS NEXT:	250 MHz	33.2 dB
ACR:	250 MHz	3.0 dB
PS ACR:	250 MHz	1.3 dB
ELFEXT	250 MHz	19.3 dB
PS ELFEXT:	250 MHz	15.3 dB
Return Loss:	250 MHz	10 dB

7. The jacket color for CAT 6 cable shall be blue.

8. Basis of Design:

a. Hubbell Nextspeed CMP

2.2 FACEPLATES/JACKS

A. CAT 6 Jacks:

1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Engineer.
3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack CAT 6 to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.
5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that fits over and/or into the modular jack opening. The dust cover shall be designed to remain with the modular jack assembly when the modular jack is in use. No damage to the modular jack pinning shall result from insertion or removal of these covers. Dust covers that result in deformation of the modular jack pinning, will not be accepted.
7. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall (1) match the faceplate color used for other utilities in the building or (2) when installed in surface raceway (if applicable), match the color of that raceway.

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8. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
 9. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.
 10. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
 11. CAT 6 modular jacks shall be pinned per TIA-568A.
 12. CAT 6 termination hardware shall, as a minimum, meet all of the mechanical and electrical performance requirements of the following standards:
 - a. ANSI/TIA/EIA-568-A-5
 - b. ANSI/TIA/EIA-568A
 - c. ISO/IEC 11801
 - d. IEC 603-7
 - e. FCC PART 68 SUBPART F
 13. The color for CAT 6 jacks shall be ivory.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Engineer prior to installation. Changes to the contract documents shall be approved by the Engineer.
2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.
5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.
6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.
7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
8. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to

allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.

9. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:
 - a. Twelve (12) inches from power lines of <5-kVa.
 - b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
 - c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
 - d. Thirty-nine (39) inches from transformers and motors.
10. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

B. Horizontal Cabling in Modular Furniture:

1. This Contractor shall be responsible for providing and installing cable completely to the information outlet in the furniture. This Contractor's responsibility does not end at the furniture feed point.
2. Where modular furniture is installed without wall contact, the Contractor shall install cabling through floor/ceiling fittings as shown on the drawings.
3. Cabling shall be protected in the transition from the floor or wall fittings to the modular furniture via a length of flexible plastic conduit or other approved protective means. Conduit fittings shall be compatible with the Floor and Wall Fittings proposed. There shall be no exposed cable in the transition to the modular furniture. Fill ratio (cable area vs. conduit area) in each feed shall not exceed 40%.
4. For purposes of bidding, it is to be assumed that the cable pathway shall be limited to the bottom panel of the modular furniture only. Communications cables would be run through these channels to the jack location.
5. For purposes of bidding, it is to be assumed that it will be the responsibility of the Contractor to punch and reinstall the bottom molding panels on the modular furniture as required to accommodate the communications cabling and information outlets. The panels shall be marked prior to installation by the Owner to identify the desired location of the information outlets.
6. The information outlet shall be secured to the panel via mounting tabs, pop-rivets, screws or other approved method. Use of adhesive tape is not acceptable. The method of securing the information outlet to the panel shall not result in sharp protrusions (e.g., sheet metal screw tip) into the channel behind the panel.

3.2 CABLE TERMINATION REQUIREMENTS

A. Cable Terminations - Data UTP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.
2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.

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3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

END OF SECTION 27 15 00

SECTION 27 17 10 - TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED SECTIONS

- A. Section 27 05 00 – Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.

1.4 SUBMITTALS

- A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work, the Contractor shall submit:
 1. Complete information on testing procedure as described herein.

PART 2 - PRODUCTS

2.1 TESTING COPPER

- A. General Requirements:
 1. The Contractor is responsible to perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.
 2. The Contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. Prior to testing, the Contractor should provide a summary of the proposed test plan for each cable type including equipment to use used, setup, test frequencies or wavelengths, results format, etc. The method of testing shall be approved by the Engineer.
 3. The Contractor shall visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. The Contractor shall provide the Engineer with a written certification that this inspection has been made.
 4. The Contractor shall conduct acceptance testing according to a schedule coordinated with the Owner/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. The Contractor shall provide a minimum of one (1) week's advance notice to the Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
 5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.
 6. The Contractor shall provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Engineer, the Contractor shall provide copies of the original test results.

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7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
 8. Should it be found by the Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings, with respect or regard to the quality, amount or value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.
 - a. CAT 6 Cable:
 - 1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.
 - 2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split or mis-positioned pairs must be identified and corrected.
 - 3) CAT 6 horizontal cable shall also be tested to 250 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Basic Link" including cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:
 - a) Wire Map
 - b) Length
 - c) NEXT Loss (Pair-to-Pair)
 - d) NEXT (Power Sum)
 - e) ELFEXT (Pair-to-Pair)
 - f) ELFEXT (Power Sum)
 - g) Return Loss
 - h) Attenuation
 - i) Propagation Delay
 - j) Delay Skew
 - 4) The maximum length of horizontal cable shall not exceed 295 feet (90m), which allows 33 feet (10 m) for technology equipment and modular patch cords.
 - 5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6 modular connector (8-pin) to facilitate testing. Net Propagation Velocity (NPV) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NPV data is available from the cable manufacturer for the exact cable type under test.
 - 6) CAT 6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Field testers that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.

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- 7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacement and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment or installation method, and shall make additional tests as the Engineer deems necessary at no additional expense to the project or user agency.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms shall become the property of the Owner.
3. The Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

B. Copper Media Test Data:

1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or Outlet) I.D., measurement direction, test equipment type, model and serial number, date, reference setup, and crew member name(s).
2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the documentation package. The Contractor shall furnish this information in electronic form (CD-ROM). The CD-ROM shall contain the electronic equivalent of the test results as defined by the bid specification and be of a format readable by Microsoft Word (Version 6.0 or newer). The Contractor shall provide a licensed copy of the software required to view and print the data that is provided in a proprietary format. The Contractor shall furnish one (1) copy of the Data and Display (if applicable) software.

C. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION 27 17 10

SECTION 27 17 20 - SUPPORT AND WARRANTY

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes support and warranty requirements relating to the structured cabling system and related subsystems.

1.2 RELATED SECTIONS

- A. Section 27 05 00 – Basic Technology Systems Requirements.

1.3 QUALITY ASSURANCE

- A. Refer to Section 27 05 00 for relevant standards.

PART 2 - PRODUCTS

2.1 MANUFACTURER REQUIREMENTS

- A. The Basis of Design for all structured cabling components is listed in the individual Division 27 sections. Alternative acceptable manufacturers will be accepted for this project.
- B. Additional acceptable manufacturers for horizontal cabling:
 - 1. Belden/CDT
 - 2. Systimax
 - 3. Berk-Tek Ortronics

2.2 WARRANTY

- A. A twenty-five (25) year Product Installation Warranty and System Assurance Warranty shall be provided for the structured cabling system as described in the contract documents.
- B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and labor for the replacement or repair of such defective product(s).
- C. The system assurance warranty shall cover the failure of the wiring system to support the application it was designed to support, as well as additional applications introduced in the future by recognized standards or user forums that use the TIA/EIA 568A component and link/channel specifications for cabling.
- D. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with a numbered certificate from the manufacturing company registering the installation.

PART 3 - EXECUTION

NOT APPLICABLE

END OF SECTION 27 17 20

SECTION 27 21 33 - WIRELESS ACCESS POINTS (WAP)

PART 1 – GENERAL 1

 1.1. SCOPE 1

 1.2. RELATED SPECIFICATIONS 1

 1.3. SUBMITTALS 1

PART 2 - PRODUCTS 1

 2.1. WIRELESS ACCESS POINT (WAP) DEVICES 1

PART 3 - EXECUTION 1

 3.1. OWNER RESPONSIBILITIES 1

 3.2. CONTRACTORS RESPONSIBILITIES 2

 3.3. FINAL TESTING 2

 3.4. WARRANTY 2

PART 1 – GENERAL

1.1. SCOPE

- A. The work under this section is for the installation of OWNER PROVIDED, CONTRACTOR INSTALLED Wireless Access Points (WAP).
- B. The WAPs shall be installed by the contractor providing and installing the Communications Cable and Equipment. All contractor qualifications and certifications for that section shall apply to this section.

1.2. RELATED SPECIFICATIONS

- A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the complete installation of WAP's. This includes but is not limited to the following:
 - 1. 01 31 23 Project Management Web Site
 - 2. 01 33 23 Submittals
 - 3. 27 00 05 Communications Cable and Equipment

1.3. SUBMITTALS

- A. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package as indicated under Specification 27 00 05.
- B. No submittals are required for the owner provided WAP.
- C. Submittals are required for installation/hanger equipment, connectors, and any other required equipment/material required for a complete WAP installation.

PART 2 - PRODUCTS

2.1. WIRELESS ACCESS POINT (WAP) DEVICES

- A. The City of Madison Information Technology Department (CoM-IT) will be providing the WAP devices for this project.
- B. The WAP device being used will be as manufactured by the Cisco, Model 3700E and shall be used for all types of ceiling mounted installations (suspended, gyp board, open truss, etc).

PART 3 - EXECUTION

3.1. OWNER RESPONSIBILITIES

- A. The CoM-IT shall be responsible for ordering, making payment (including shipping fees), and configuring all WAP devices in a timely manner to comply with the Contractors schedule.
- B. The CoM-IT shall configure and test each WAP to CoM-IT specifications prior to providing them to the contractor for installation.
- C. The CoM-IT shall number each WAP and provide the contractor with a location map indicating where each WAP will be installed.
- C. The CoM-IT shall test all WAP's after installation to verify configuration and signaling is correct prior to accepting the final installation of the WAP system.

3.2. CONTRACTORS RESPONSIBILITIES

- A. The Contractor shall be solely responsible for coordinating with CoM-IT the scheduling and receipt of all WAP devices with his/her installation schedule.
- B. The Contractor shall inspect all WAP devices upon receipt for damage. CoM-IT shall be notified immediately of any damage.
- C. The Contractor shall provide all mounting hardware, blocking, and other items required for a complete installation to the manufacturers installation requirements.
- D. The Contractor shall install all WAP devices per plans and specifications including cable connections.
- E. The Contractor shall be responsible to pick up WAP devices from City IT and delivery to the jobsite.

3.3. FINAL TESTING

- A. Contractor shall provide final testing of all WAP devices after installation is complete.
- B. In the event any WAP device is not operating properly the contractor shall trouble shoot the installation and work with the CoM-IT to determine if re-configuration of the device will be required.
- C. The CoM-IT shall be responsible for reconfiguring WAP's as needed after installation is complete. The contractor shall be responsible for verifying connections, cabling and connectivity of the installation is correct.

3.4. WARRANTY

- A. The CoM-IT will be responsible for registering any warranty information associated with the purchase and ownership of all WAP devices.
- B. The Contractor shall warrant the installation of the WAP device for one (1) year per the terms of this contract.

END OF SECTION 27 21 33

SECTION 27 41 23 - AUDIO-VIDEO ACCESSORIES

PART 1 – GENERAL 1

1.1. SUMMARY 1

1.2. RELATED SPECIFICATIONS 1

1.3. AREAS OF RESPONSIBILITY 1

1.4. SUBMITTALS 2

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PART 2 - PRODUCTS 2

2.1. PRODUCTS FURNISHED BY OWNER 2

2.2. PRODUCTS FURNISHED BY CONTRACTOR 2

2.3. WALL MONITORS 2

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2.5. IP CABLE BOX 3

PART 3 - EXECUTION 3

3.1. CONTRACTOR COORDINATION 3

3.2. GENERAL INSTALLATION REQUIREMENTS 3

3.2. EQUIPMENT INSTALLATION, TESTING, AND ACCEPTANCE 4

PART 1 – GENERAL

1.1. SUMMARY

- A. This specification shall identify equipment components and accessories required to complete Audio-Video (A/V) installations not previously identified in other Division 27 specifications. It does not include materials such as cables, boxes, connectors, conduit, supports and other ancillary equipment required to complete the installation.
- B. This specification shall clearly identify responsibilities of various contractors and the Owner including project coordination, installation, and testing of installed components.
- C. For the purposes of this specification the term Contractor shall refer to the person(s) responsible for installing and integrating the A/V components and equipment described herein, and may or may not be the same contractor installing other Division 27 and 28 related equipment. Other contractors having related work shall be referred to by full title (Electrical Contractor).

1.2. RELATED SPECIFICATIONS

- A. 01 31 23 Project Management Web Site
- B. 01 33 23 Submittals
- C. 01 78 23 Operation and Maintenance Data
- D. 01 78 36 Warranties
- E. 01 78 39 As-Built drawings
- F. All Division 27 specifications that may apply to this installation
- G. Other division specifications that may apply to this work for coordination

1.3. AREAS OF RESPONSIBILITY

- A. The General Contractor shall be responsible for ensuring all of the following:
 - 1. Coordinate with the Contractor and the Owner or Owners Representative the scheduling, purchasing, and receiving of all Owner provided products and equipment.
 - 2. Coordinate all Contractor related work with the construction schedule.
 - 3. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and resolve installation issues as needed.
- B. The Contractor shall be responsible for all of the following:
 - 1. Direct coordination with the Owner or Owners Representatives for all equipment being provided and/or configured by the Owner.
 - 2. Verification of Owner installation requirements prior to installing equipment and accessories.
- C. The Owner or Owners Representatives shall be responsible for all of the following:
 - 1. Coordinating all purchases and deliveries of the Owner provided equipment to the project site with the GC and Contractor so as not to delay the installation or project schedule.
 - 2. Coordinate the pre-installation configuration of any A/V equipment so as not to delay the installation or project schedule.

1.4. SUBMITTALS

- A. The Contractor shall not be required to provide submittals for equipment being provided by the Owner but shall provide submittals for ancillary equipment as needed under this specification or other Division 27 specifications.
- B. The Contractor shall provide submittals of the following:
 - 1. All applicable certifications and licenses of the Contractor and the Contractor's installation team. Applicable certifications and licenses shall be current from the start of the contract through the end of the warranty period.
 - 2. One (1) submittal for all ancillary A/V and A/V Contractor provided equipment required for a complete A/V installation as follows:
 - a. Product information sheets and shop drawings indicating each type/size/model of A/V accessory required for a complete A/V installation. Information sheets shall include the following information:
 - i. Performance data for the item
 - ii. Plan identification number(s) where applicable
 - iii. Quantity required for each model

1.5. WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
 - 1. The Contractors warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install of any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

PART 2 - PRODUCTS

2.1. PRODUCTS FURNISHED BY OWNER

- A. The following products shall be furnished by the owner under this specification.
 - 1. Wall monitors as indicated in the plans and specifications (see section 2.3 below).
 - 2. IPTV cable boxes

2.2. PRODUCTS FURNISHED BY CONTRACTOR

- A. The Contractor shall furnish all material and equipment required for a complete A/V installation per the plans and specifications except where indicated as furnished by Owner.
- B. All products, materials and equipment furnished by the contractor shall be new and meet all applicable codes.
- C. The Contractor shall provide the following equipment as noted within this specification:
 - 1. All monitor wall mounts.
 - 2. All power amplifiers

2.3. WALL MONITORS

- A. New wall monitors furnished by Owner shall be of like kind and quality to the monitors listed in the Technology Equipment Schedule on sheets T100 and T101 of the plan set.

2.4. WALL MOUNTS (MONITOR)

- A. The Owner shall provide wall mount brackets for all wall monitor installations noted in the construction documents.
- B. Wall mount brackets shall be appropriately sized to support the monitor sizes described in the construction documents.
- C. Each monitor in ganged monitor applications shall have its own mounting bracket, shared brackets will not be allowed. All mounting brackets in ganged monitor applications shall be similar models by the same manufacturer.

-
- D. Wall mount brackets for monitors shall meet the following requirements regardless of size:
 - 1. Black powder coat finish
 - 2. Minimum vertical tilt +15/-5 degrees
 - 3. Thin profile to minimize wall clearance when installation is complete
 - 4. All monitors shall have fully articulating arms with a minimum 18" horizontal extension to provide a wide range of motion and/or to facilitate the removal of the monitor without having to remove adjacent monitors.
 - 5. Models as manufactured by:
 - a. Peerless-AV
 - b. Chief Manufacturing
 - c. Omnimount
 - d. Premier Mounts
 - e. Video Mount Products
 - f. No other substitutions will be allowed

2.5. IP CABLE BOX

- A. IP Cable Boxes shall be provided by the Owner and installed by the Contractor. This section is being provided as informational only. The Contractor shall be responsible for providing/installing the input to the cable box and the output to the monitor.
 - 1. Amino Communications, Aminet A140, cable box
 - a. Input = Ethernet 10/100 BaseT via RJ-45 shielded connector
 - b. Output = HDMI 1.3A with HDCP
 - c. Power = 120V
 - d. Decodes up to 720p and 1080i; displays up to 1080p
 - e. HD graphics up to 1280x720
- B. The Owner shall designate which model is required at each location.

2.6 SPEAKERS

- A. The contractor shall provide the following speakers or those of similar quality.
 - 1. Similar to Bogen Model: S810T725PG8WVR. 70 volt, 4 watt, ceiling mounted. Provide speaker and all mounting hardware to make for a complete installation.
 - 2. Similar to Bogen WBS810T725, 70 volt, 4 watt, wall mount. Provide speaker and all mounting hardware to make for a complete installation.

2.7 Power Amplifier

- A. The contractor shall provide the following speakers or those of similar quality.
 - 1. Similar to Extron Model: XPA 2001. 200 watt, wall, rack or under-table mount. Coordinate mounting on site in each room with owner and architect. Can mount behind monitor but must be accessible. Can provide Under Table Shelf similar to Extron UTS 100 Series shelf.

PART 3 - EXECUTION

3.1. CONTRACTOR COORDINATION

- A. The Contractor shall coordinate with the General Contractor (GC) and all other trade contractors as needed for the installation of the A/V Accessories. Coordination shall include a pre-installation meeting during rough-in to ensure blocking, power outlets, and data outlets are properly located.
- B. The Contractor shall review all plans and specifications indicating wall and position requirements for accessory A/V equipment and install all required equipment accordingly.
 - 1. The Contractor shall coordinate all connection and installation requirements with other trade contractors doing Division 27 Work.

3.2. GENERAL INSTALLATION REQUIREMENTS

- A. Cables/cords shall be properly plugged in. Excess cable/cord shall be neatly looped and bundled using Velcro cable ties. Zip ties, wire ties, and other rigid, semi-permanent restraints will not be allowed.
 - 1. Excess cables/cords shall not be visible after the installation is complete.
 - a. Example: Cables/cords behind wall monitors shall be neatly bundled behind the monitor and fastened to the monitor wall mount so as not to be visible from the front of the monitor.

-
- B. Equipment mounts shall be properly sized for the equipment being supported. Fasteners shall be of sufficient strength to support the finished installation including required equipment.
 - 1. Fasteners shall be firmly attached to blocking where provided.
 - 2. Fasteners in solid materials such as concrete, brick, etc shall use appropriate sleeves and anchors for the material, weight being supported, and fastener being used.
 - 3. All drop ceiling mount locations shall have tile bridge supports.
 - C. Final testing of A/V components shall be performed only after all A/V equipment and components within Division 27 have been completely installed to ensure all components have been properly integrated with each other as needed.

3.2. EQUIPMENT INSTALLATION, TESTING, AND ACCEPTANCE

- A. Any required system programming (by CoM-IT or Contractor) shall be completed prior to doing any installation testing and acceptance.
- B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.
- C. Wall Mounts:
 - 1. Wall mounts shall be securely fastened to the wall and blocking per the manufacturer's supplied instructions and mounting hardware. Wall mounts shall be located horizontally and vertically on the designated wall as indicated in plans and details for each room receiving monitors.
 - 2. Monitors shall be securely installed on the wall mount.
 - 3. The mounting bracket shall be tested with the completed monitor and cable/cords properly installed. The completed installation and successful testing of the mounting bracket installation shall provide the following:
 - a. All cords/cables are properly plugged in, excessive cable is bundled but not stretched tight, cords/cables are not pinched or impede the mounting brackets range of motion.
 - b. Full range of motion in all directions as per the specifications above.
- D. Monitor testing shall be part of the overall Division 27 installation of all A/V equipment and requirements. This shall include but not be limited to the following:
 - 1. Remote control is fully functional at each monitor location
 - a. A single remote is used and properly programmed to control monitors, IPTV cable boxes and other devices as needed.
 - i. Controls on/off/volume and other related functions as a TV with an IP Cable Box.
 - ii. Controls various input modes as a monitor as described in other Division 27 specifications.
 - iii. Works with other video/audio feeds as described in other Division 27 specifications.
 - 2. Monitor (each location) functions in all modes and inputs as designated in the contract documents.
 - a. Test with Polycom system
 - b. Test with portable devices (laptop, etc)
- E. The IP Cable Box shall be tested at each location installed. Testing shall include verifying all intended functions perform as expected. Troubleshoot and re-test as necessary. Contact Owners Representative if a bad unit is suspected for immediate replacement.
- F. A completed and accepted installation shall pass all of the above tests for each location where equipment will be installed.
- G. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION 27 41 23

SECTION 27 41 43 - AUDIO-VIDEO CONFERENCING (POLYCOM)

PART 1 – GENERAL 1

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PART 1 – GENERAL

1.1. SUMMARY

- A. These specifications describe the materials, equipment, and installation requirements to install a fully integrated, audio-video conferencing system (Polycom) currently in use by the City of Madison (Owner).
- B. The Polycom System Contractor (Contractor) shall be responsible for verifying equipment requirements, locations, and coordination with the General Contractor and all other necessary trades as needed for a complete installation.

1.2. RELATED SPECIFICATIONS AND REFERENCES

- A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the complete installation of A/V Accessories associated with this specification. This includes but is not limited to the following:
 - 1. 01 31 23 Project Management Web Site
 - 2. 01 33 23 Submittals
 - 3. 27 05 00 Basic Communication Systems Requirements
 - 4. 27 41 23 Audio-Visual Accessories
- B. The Contractor shall be familiar with all Polycom best practice guides for system design and component placement. The Contractor shall be responsible for reviewing all plans and providing written notification to the Architect and owner in the event the plan set is in error.

1.3. RELATED DRAWINGS

- A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line voltage locations.
- B. Refer to all Technical drawings for locations of Polycom and other related audio visual equipment.
- C. Refer to Architectural floor plans and details for information relating to equipment shelves, wall location, and blocking requirements.

1.4. POLYCOM SYSTEM CONTRACTOR QUALIFICATIONS

- A. The Contractor and staff working on site shall be a certified in all of the following aspects associated with the complete installation of the specified Polycom system:
 - 1. Polycom Platinum Solution Advisor in the Polycom Certified/Specialized Partner Program.
 - 2. Certification in or partnership with Crestron control systems.
 - 3. Certified Technology Specialist (CTS) certification is required.
- B. The Contractor shall also be able to meet the following service/support requirements through the duration of the warranty period:
 - 1. Be based within 100 radial miles of the project location
 - 2. Be able to provide 24/7/365 support during the warranty period of this project
 - 3. Be able to respond and repair or replace most components within 4 hours of notification

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4. Provide unlimited access to A/V Technicians with room documentation for remote support.
 5. Returned Materials Authorization (RMA) assistance for equipment failures
 6. Immediate connection to support center from room system touch-panel
 7. On-site services for issues that cannot be resolved via remote trouble shooting

1.5. AREAS OF RESPONSIBILITY

- A. The Owner and City of Madison Information Technology Department (CoM-IT) shall be responsible for all the following:
 1. Review the plans and Polycom Best Practice Requirements for each installation with the Contractor.
 2. Order & purchase all major Polycom components in quantities per the comprehensive list generated by the Contractor. Provide estimated delivery dates to the Contractor with confirmation of orders. The Owner and CoM-IT shall be responsible for the following major Polycom components:
 - a. Codecs, by owner
 - b. Cameras, by owner
 - d. Microphones, by owner
 2. The CoM-IT shall be responsible for programming the Polycom codecs.
 3. The Owner shall not be responsible for ancillary equipment required to complete the installation.
- B. The General Contractor (GC) shall be responsible for the following:
 1. Coordinating progress scheduling with the Contractor for all A/V related equipment.
 2. Coordinating scheduling with the Owner for the timely purchase of equipment.
 3. Receiving all A/V equipment delivered to the construction site and notifying the Contractor and Owner of its arrival.
 4. Providing dry and secure storage for all A/V equipment until installed.
- C. The Contractor shall be responsible for the following:
 1. The Contractor shall review with CoM-IT the plans and Polycom Best Practice Requirements for each installation. The Contractor shall provide a comprehensive list of major components and quantities to be ordered/purchased by the Owner.
 2. Coordinating/reporting installation progress with the GC, Owner, and CoM-IT.
 3. Inspect all Polycom equipment packages delivered to the site for shipping damage within two (2) working days of arrival. Inform the GC and Owner if any damage is found.
 4. Thoroughly inspect all Polycom equipment prior to installation.
 5. Properly install all Polycom equipment provided by the Owner as per plans and specifications.
 6. The Contractor shall be responsible for all software programming associated with the control panels.
 7. Provide and install all ancillary equipment required for a complete system installation. Ancillary equipment shall include but not be limited to the items referenced below. See other division 27 specifications for additional A/V installation requirements.
 - a. Connector cables, connector ends, and cable ties
 - b. All boxes and covers required for Polycom equipment during rough-in
 - c. All mounts and hangers required for a complete installation as per the plans and specifications.
- D. The following equipment shall be provided by the contractor under the A/V specification and drawings as noted to complete the Polycom installation:
 1. Speakers: Pre-assembled baffle with white perforated steel grille and speaker assembly. Equip with 8" loudspeaker with 10-ounce magnet, universal matching transformer for 25 or 70 volt system with a minim of five secondary transformer taps. Provide matching back box and tile bridge.

1.6. SUBMITTALS

- A. The Contractor will not be required to provide submittals for equipment being provided by the Owner but shall provide submittals for ancillary equipment as needed under this specification or other Division 27 specifications.
- B. The Contractor shall provide a submittal of the following:
 1. All certifications of the contractor and contractor's installation team. Certifications shall be current from the start of the contract through the end of the warranty period.
 2. Cut sheets indicating, shop drawings, performance data, and other such information that will indicate the component being installed matches the component that was specified.

1.7. WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
 - 1. The Contractors warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install of any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

PART 2 - PRODUCTS

2.1. GENERAL

- A. To ensure compatibility with existing equipment, minimize multiple system configurations and maintenance the City of Madison will be providing the major Polycom components for each of the two (2) installations identified in item 2.2. below.
- B. The Contractor shall be responsible for providing all ancillary equipment, cable, boxes, conduit and other such devices required to complete the Polycom installations. All ancillary equipment shall be of a high quality and where applicable as recommended by Polycom.

2.2. NEW EQUIPMENT

- A. The Contractor shall be solely responsible for coordinating the scheduling and receipt of all new equipment being provided by the CoM-IT.
- B. Equipment described in items C and D below include the number of cameras as designated, codec, microphone, but does not include related monitor equipment. See Specification 27 41 23 Audio-Visual Accessories for monitor and speaker specifications.
- C. The following new equipment shall be supplied by the Owner (CoM-IT) and installed by the Contractor:
 - 1. One (1) 1-camera Polycom GS500*, ceiling microphone, for Incident Command Room B005
 - 2. One (1) 1-camera Polycom GS500*, floor microphone, for Brief 115
- D. The * in items C.1., C.2., above shall be integrated with other A/V system equipment including but not limited to multiple monitors, control devices or external speakers provided by this Contractor.

PART 3 - EXECUTION

3.1. CONTRACTOR COORDINATION

- A. The Contractor shall coordinate with the General Contractor (GC) and all other trade contractors as needed for the installation of the Polycom systems. Coordination shall include a pre-installation meeting during rough-in to ensure blocking, power outlets, and data outlets are properly located.
- B. The contractor shall coordinate with the GC, Owner, Architect, and CoM IT a pre-installation walk through to verify all equipment locations including but not limited wall mounting locations, ceiling mounting locations, and floor outlet connections where applicable.

3.2. EQUIPMENT MOUNTING

- A. All other plans and specifications shall apply to equipment mounting. In general terms:
 - 1. The GC shall be responsible for all backer boards and mounting of A/V equipment shelves
 - 2. The Electrical Contractor shall be responsible for all line voltage outlets
 - 3. The Data Cabling contractor shall be responsible for all data and A/V cable boxes and wiring in support of the Polycom system
 - 4. The Polycom Contractor shall be responsible for the installation of all Polycom equipment, hangers, supports and component cabling.

3.3. CONDUITS AND WIRING

- A. General Conduit and wiring shall be provided as per 3.2.A.2. and 3.2.A.3. above.

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- B. The finished Polycom installation shall be neat in appearance. All excess cabling shall be properly bundled using Velcro cable straps only.

3.4. INSTALLATION TESTING AND ACCEPTANCE

- A. All codec programming (by CoM IT) and software programming (Contractor) shall be completed prior to doing any installation testing and acceptance.
- B. It is the sole responsibility of the Contractor to notify CoM IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.
- C. The Contractor and CoM IT shall test each Polycom installation to ensure the installed components work per the specifications.
 - 1. All installed components shall be inspected as follows:
 - a. All connections are tight, where applicable thumb screws have been properly installed and are finger tight
 - b. All components are clean and free of dust, finger prints and other general dirt
 - c. Camera lenses are clean and free of lint, dust and finger prints
 - d. Cameras are free to rotate
 - e. Excess cabling has been neatly wrapped with Velcro wire wraps and are properly stored
 - 2. Each Polycom installation at the project site shall be tested with an offsite Polycom installation to ensure that all the following performance measures have been achieved:
 - a. All network connectivity is complete and installed properly.
 - b. Audio input (Polycom microphone, table top or ceiling mounted)
 - c. Audio output
 - d. Camera input
 - e. Video output (may be one or more monitors)
 - f. Refer to Specification 27 41 23 Audio-Visual Accessories for additional testing procedures of Polycom systems (identified in item 2.2.E. above) with A/V integrated equipment.
- E. A completed and accepted installation shall pass all the above tests for each installed Polycom location.
- F. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION 27 41 43

SECTION 27 53 19 - PUBLIC SAFETY REPEATER SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cabling and components.

1.2 RELATED WORK

- A. Section 27 13 00 Backbone Cabling Requirements

1.3 QUALITY ASSURANCE

- A. Manufacturer: The Public Safety Repeater System shall be a single-source manufacturer such that the single manufacturer distributes, supports, warranties, and services all major components. The manufacturer shall have a minimum of five (5) years documented experience and have been approved for use by public safety networks (PSN).
- B. Installer: The installing dealer must be a factory-authorized service and support company specializing in the selected manufacturer's product, with demonstrated prior experience with the selected manufacturer's system installation and programming.
- C. Servicing Contractor: The manufacturer of the system must have local service representatives within 60 miles of the project site.

1.4 REFERENCES

- A. EIA – Electronics Institute of America Standards
- B. NFPA 70 – National Electrical Code

1.5 SUBMITTALS

- A. Submit data under provisions of Section 27 05 00.
- B. Product Data Submittal: Provide manufacturer's technical product specification sheet for the following:
 - 1. Donor and coverage antennas
 - 2. Cable and connectors
 - 3. Splitters, combiners and couplers
 - 4. Bi-directional amplifiers (BDA)
 - 5. Fiber optic master and remote units
- C. The Contractor shall submit a conceptual design for the Architect/Engineer to review. The conceptual design shall include the system topology, bandwidth usage, and materials list with all major devices and cut sheets as listed above. Design drawings shall include:
 - 1. Project specific system CAD drawings/ floor plans of the proposed locations of antennas, equipment locations, vertical pathways, and all necessary grounding
 - 2. RF link budget and propagation modeling plan
 - 3. Materials list to include product description and model number
- D. Identify all power requirements to include receptacle type, voltage and phase.
- E. Submit proof of certification of the DAS system the Contractor is proposing.

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- F. Submit a letter of good standing with the proposed manufacturer.
 - G. Submit detailed description of Owner training to be conducted at project end, including suggested training duration.

1.6 DEFINITIONS

- A. AHJ – Authority Having Jurisdiction
- B. ATP – Acceptance Test Plan
- C. AWS – Advanced Wireless Service
- D. BDA – Bi-Direction Amplifier
- E. FCC – Federal Communications Commission
- F. PSN - Public Safety Networks

1.7 SYSTEM DESCRIPTION

- A. This section describes the technical and performance criteria for the installation of a Public Safety Network capable of supporting public safety networks (PSN).
- B. Performance Statement: This section and the accompanying design documents are performance based, describing the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment and connection that must be made. Based on the equipment constraints described and the performance required of the system, as presented in these documents, the Contractor is solely responsible for determining all wiring, programming, and miscellaneous equipment required for a complete and operational system.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit data under provisions of Section 27 05 00.
- B. Final As-Built Drawings: Include up-to-date drawings that include any changes made to the system during installation.
- C. Submit certificate of completion of installation and service training from the system manufacturer.
- D. Test reports confirming the project requirements have been met.
- E. Test results on all cable runs.
- F. Warranty: Submit written warranty and complete all Owner registration forms.
- G. Complete all operation and maintenance manuals as described below.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 27 05 00.
- B. Product Certificates: Signed by manufacturer of DAS equipment certifying that products comply with requirements.
- C. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.
- D. Manufacturer Certificates: Signed by manufacturers certifying the Contractor has complied with manufacturer requirements.
- E. Field Tests Reports and Observations: Include record of final adjustments certified by Installer.

F. Maintenance Data: Include the following in maintenance manuals:

1. Operating instructions
2. Troubleshooting guide
3. Wiring terminal identification
4. Equipment parts list

1.10 WARRANTY

- A. Contractor shall provide a one (1) year warranty of the installed system equipment defects in material and workmanship. All labor and materials shall be provided at no expense to the Owner during normal working hours. Warranty period shall begin on the date of acceptance by Owner/Architect/Engineer.
- B. The warranty shall include emergency service and repair on site, with acknowledgment response time of four (4) hours from time of notification and on-site response within one (1) working day. The warranty shall include next day delivery of replacement parts required to make system operational.
- C. Contractor shall submit an emergency repair plan to the Owner for acceptance prior the final acceptance.

1.11 SYSTEM TESTING AND ACCEPTANCE

- A. Inspection of the installed systems shall be made by the Owner and Architect/Engineer. If items from the design documents have been omitted or need changing per the requirements stated herein, they shall be noted in a punch list. The punch list will be expected to be fully complete within the time specified by the project. The system must be delivered, installed and accepted by Owner and Architect/Engineer. The acceptance criteria shall include, but not be limited to, the following:
1. Owner and Architect/Engineer will make an inspection, as deemed necessary, when notified by the Contractor that the equipment/ software, or any part thereof, is ready for acceptance.
 2. After cutover of any portion of the system, the Contractor shall conduct acceptance test consistent with manufacturer's system performance specifications and as outlined in manufacturer's documentation.
 3. Performance and reliability tests shall be conducted, demonstrating acceptable performance, over a full 30-day period after cutover.
 4. Acceptance of the system shall be granted after all equipment has passed the tests contractually agreed to, has been in operation for 30 consecutive days without a major failure, and after proper system training as outlined within the contract documents has been conducted. In the event of a major failure, the Owner reserves the right to extend the acceptance date until such time that the installation complies with the 30 consecutive day major fault free requirement.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The acceptable manufacturers for this project are:
1. CommScope / Andrew
 2. Corning
- B. Contractor shall submit only one approved manufacturers.

2.2 BASIC SYSTEM REQUIREMENTS

- A. System shall include, but not be limited to, antennas, cabling, connectors, splitters, combiners, couplers, fiber optic cabling and connectors (if applicable), and bi-directional amplifiers to provide a complete system.
- B. The system shall provide coverage for the PSN listed below:
 - 1. 800 MHz to support police, fire and life safety
- C. Contractor shall meet with Owner to identify which PSNs identified above will be servicing the facility. Contractor shall arrange a meeting with PSN to propose their system can receive signals, and get approval from PSN prior to submitting final design documents to the Owner.
- D. System shall be designed to support 24/365 day operation.
- E. System shall be compatible with current technologies
- F. System Requirements:
 - 1. The Public Safety Repeater system shall be designed to support the following minimum received signal levels (RSL) within the facility. Facility coverage shall include 95% of the facility to include stairwells, elevators, basements, and garages if applicable.

Received Signal Levels (RSL)				
Description	Unit	Lower 700 MHz	Cellular, PCS, AWS, Commercial 800/900 MHz	Public Safety 380 - 512, 700, 800 MHz
Minimum receive signal level (RSL)	dBm	-77	-85	-95

- 2. The DAS shall support the following frequencies:

SERVICE	FREQUENCY UPLINK	FREQUENCY DOWNLINK
Lower 700 Band	698 - 716	728 - 746
Upper 700 Band	746 - 776	776 - 805
800 Band	806 - 824	851 - 869
900 Band	896 - 902	935 - 941

- G. Backup Power:
 - 1. The system shall be provided with battery or uninterruptible power supply (UPS) power where active equipment is located for not less than two (2) hours upon loss of power. System shall remain fully functional upon loss and return of power and not require a restart in any condition.

2.3 PRODUCTS

- A. System Components: Listed below are the minimum products required for this system installation. Contractor shall provide a complete installation utilizing these devices and any other equipment / device necessary to provide a complete turn-key installation.
 - 1. Base unit
 - 2. Remote cabinet
 - 3. System controller

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4. Bi-directional amplifier
 5. System controller
 6. Cable, connectors, splitters, combiners
- B. Base Unit:
1. The base unit performs RF to optical signal conversion. The unit is available in multiple port configurations.
- C. Remote Cabinet:
1. The remote cabinet supports multiple remote modules and can be mounted to the wall or within the equipment rack.
- D. System Controller:
1. The system controller provides management of the Public Safety Repeater system by the end user. System management can be controlled via the network. Unit is provided with multiple RJ-45 powers, dry contact alarm inputs, and connectors for auxiliary alarm connections.
- E. Remote Unit:
1. The remote unit can be installed within the remote cabinet or mounted directly to the wall or equipment rack. This unit provides bi-directional transmission of signals between antenna and system head end via fiber and coaxial cable.
- F. Bi-Directional Amplifier:
1. Bi-directional amplifier is used to ensure and filter signal levels between the RF source and base unit. The BDA is available in multiple port configurations and can be mounted to the wall or equipment rack.
- G. Antennas:
1. Shall support multi-band and accommodate all frequencies identified above.
 2. Be either omni or directional indoor and/or outdoor.
- H. Cable, Connectors, Splitters, Combiners, Etc.:
1. Fiber Optic Cable: Refer to Section 27 13 00 for additional information.
 2. Coaxial Cable:
 - a. Cable shall be air dielectric plenum rated.
 - b. Outer material shall be corrugated aluminum or copper.
 - c. Inter material shall be copper clad aluminum wire.
 - d. Refer to manufacturer specifications on cable type for each antenna application.
 3. Splitters, Combiners, Taps, Connectors:
 - a. Refer to manufacturer specifications for additional information.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install all equipment and components in accordance with manufacturer's written instruction, in compliance with recognized industry practices to ensure that all items comply with specifications.
- B. Within the warranty period, Contractor shall affect replacement of defective parts within one (1) business day after receiving notification of a problem.
- C. Provide the Owner with any additional warranties offered by the manufacturer.
- D. The Contractor shall receive and stage all equipment at their facility. During this time, the equipment will be tested, burned in, and configured.
- E. This Contractor shall be responsible for all correspondence between the wireless service providers, Owner and Architect/Engineer to provide a complete installation.

3.2 INSTALLATION

- A. Contractor shall furnish and install all equipment, miscellaneous parts, accessories and programming to provide a complete and fully operational in-building distributed antenna system.
- B. Contractor shall provide all necessary pathways required by the wireless service providers to support their systems to include any pathways to the roof to support antenna cabling distribution by the Public Safety Repeater System.
- C. Contractor shall meet with the Owner to determine level of Public Safety Repeater System to be installed within the facility.

3.3 TRAINING

- A. Contractor shall provide training on all systems provided. Training sessions shall be on site, limited to 15 people maximum in any one session. Training shall be scheduled at the Owner's convenience. Sessions shall last approximately two (2) hours each. In addition, Contractor shall provide a minimum of eight (8) hours training for the system administrator.
- B. Follow-up training shall be provided for the systems a minimum of 30 days after cutover. Contractor shall coordinate times with Owner.
- C. If Contractor is not able to provide training as described, Contractor shall arrange for a representative from the manufacturer to provide training at the Contractor's expense.

3.4 FINAL CHECKOUT AND ACCEPTANCE

- A. Contractor shall verify that the system is complete and fully operational before requesting final approval and before scheduling system demonstration.
- B. Contractor shall be available to demonstrate the operation and use of the system to the Architect/Engineer and to the Owner's representatives.
- C. Contractor shall furnish three (3) complete record manuals to the Owner.

END OF SECTION 27 53 19

SECTION 28 05 00 - BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.

1.2 SCOPE OF WORK

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make their portion of the security systems a finished and working system.
- C. Description of systems include but are not limited to the following:
 - 1. Electronic Access Control System (Key Scan)
 - 2. Electronic Surveillance
 - 3. Fire Detection and Alarm
 - 4. Low Voltage Security Wiring (less than +120VAC) as specified and required for proper system control and communications.
 - 5. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".
 - 6. Firestopping of penetrations of fire-rated construction as described in Division 7.

1.3 OWNER FURNISHED PRODUCTS

1.4 WORK SEQUENCE

- A. All construction work that will produce excessive noise levels and interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during non-occupied hours. The Owner shall reserve the right to set policy as to when restricted construction hours will be required.
- B. The successful Bidders shall be responsible for scheduling overtime hours for the following work:
- C. Successful Bidders shall itemize all work and list associated hours and pay scale for each item.

1.5 DIVISION OF WORK BETWEEN ELECTRICAL AND SECURITY CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:

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1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
 2. "Electrical Contractor" shall also refer to the Contractor listed in Division 28 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
 3. "Security Contractor" as referred to herein refers to the Contractors listed in Division 28 of this Specification.
 4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems, used for analog and/or digital signals between equipment.

C. General:

1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work responsibilities as related to Security Systems including conduit, cable tray, power wiring and Low Voltage Security Wiring. The prime contractor is responsible for all divisions of work.
2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor's bid.
3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.
4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Security Wiring, the installation shall not begin until the Security Contractor has completed a coordination review of the cable tray shop drawing.
5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Electrical Busduct
 - e. Cable Trays, including 12" access space
 - f. Sprinkler Piping and other Piping
 - g. Conduit and Wireway
 - h. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
2. Assumes all responsibility for providing and installing cable tray.
3. Responsible for Security Systems grounding and bonding.

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4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Security Contractor's Responsibility:

1. Assumes all responsibility for the Low Voltage Security Wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of Security equipment which is required to be bonded to the telecommunications ground system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.6 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

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1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. KJWW will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by KJWW. KJWW will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the A/E for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.

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4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
 5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
 6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
 8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the A/E.
 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the A/E at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the A/E and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors prior to installing any of the components.
 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.
 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. Each Contractor and their subcontractors shall employ only workers who are skilled in their respective trades and fully trained. All workers involved in the installation, termination, testing, and placing into operation electronic security devices shall be individually trained by the manufacturer.
3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.

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4. The Contractor shall own and maintain tools and equipment necessary for successful installation and testing of electronic security devices and have personnel adequately trained in the use of such tools and equipment.
 5. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
 - a. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
- B. Compliance with Codes, Laws, Ordinances:
1. This Contractor shall conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other regulations having jurisdiction over this installation.
 2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
 3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, the codes and regulations shall determine the method or equipment used.
 4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.
 5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
- C. Permits, Fees, Taxes, Inspections:
1. Procure all applicable permits and licenses.
 2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
 3. Pay all applicable charges for such permits or licenses that may be required.
 4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
 5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise may be required by an authorized body.
 6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized independent agency/consultant.
 7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)
 - a. Factory Mutual
 - b. Underwriters' Laboratories, Inc.
- D. Examination of Drawings:
1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.

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2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
 3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
 4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
 5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
 6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

E. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.
2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or copies of the specifications. Specifications will be provided in PDF format.
3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic File Transmittal" form provided by KJWW.
4. If the information requested includes floor plans prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.
5. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.
6. The drawings prepared by KJWW for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
7. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
8. The information is provided to expedite the project and assist the Contractor with no guarantee by KJWW as to the accuracy or correctness of the information provided. KJWW accepts no responsibility or liability for the Contractor's use of these documents.

F. Field Measurements:

1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.8 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.

1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
28 13 00	Electronic Access Control
28 20 00	Electronic Surveillance

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:

- a. Date
- b. Project title and number
- c. Contractor's name and address
- d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- e. Description of items submitted and relevant specification number
- f. Notations of deviations from the contract documents
- g. Other pertinent data

2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- a. Date
- b. Project title and number
- c. Architect/Engineer
- d. Contractor and subcontractors' names and addresses
- e. Supplier and manufacturer's names and addresses
- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- g. Description of item submitted (using project nomenclature) and relevant specification number
- h. Notations of deviations from the contract documents
- i. Other pertinent data
- j. Provide space for Contractor's review stamps

3. Composition:

- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
- b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
- c. All sets shall contain an index of the items enclosed with a general topic description on the cover.

4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.

5. Contractor's Approval Stamp:

- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.

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- b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.**
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any equipment for manufacture or shipment.

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14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 28 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 28 XX XX.description.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted via a pre-approved method.

D. Paper Copy Submittal Procedures:

1. Paper copies are acceptable where electronic copies are not provided.
2. The Contractor shall submit ten (10) paper copies of each shop drawing.
3. Each set shall be bound in a three-ring binder or presentation binder. Copies that are loose or in pocket folders are not acceptable.

1.9 SCHEDULE OF VALUES

A. The requirements herein are in addition to the provisions of Division 1.

B. Format:

1. Use AIA Document Continuation Sheets or another similar form approved by the Owner and Architect/Engineer.
2. Submit in Excel format.
3. Support values given with substantiating data.

C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.

D. Update Schedule of Values when:

1. Indicated by Architect/Engineer.

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2. Change of subcontractor or supplier occurs.
 3. Change of product or equipment occurs.

1.10 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders with inadequate breakdown will be rejected.
- B. Change order work shall not proceed until authorized.

1.11 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a representative of the manufacturer has inspected the installation and certified that the equipment is properly installed and that the equipment is ready for operation:
 1. Firestopping, including mechanical firestop systems.

1.12 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site so as to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.13 WARRANTY

- A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.
- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.14 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.15 MATERIAL

- A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of whether a product is equivalent.

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- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured **in writing** from the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full responsibility for the unnamed manufacturer's equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.
 - D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 REFER TO INDIVIDUAL SECTIONS

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.
- D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 28 sections for further requirements.
2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 PROJECT CLOSEOUT

A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.

B. Final Jobsite Observation:

1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is not dictated by schedule, but rather by completeness of the project.
2. Refer to the end of Section 27 05 00 for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION."
3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final observation can commence.

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- C. Before final payment will be authorized, this Contractor must have completed the following:
1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
 2. Submitted bound copies of approved shop drawings.
 3. Record documents including edited drawings and specifications accurately reflecting field conditions, **inclusive** of all project revisions, change orders, and modifications.
 4. Submitted a report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
 5. Submitted testing reports for all systems requiring final testing as described herein.
 6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
 7. Provide spare parts, maintenance, and extra materials in quantities specified in individual specification sections. Deliver to project site insert address here; submit receipt to Architect/Engineer prior to final payment being approved.

3.5 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div28.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD
5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.

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6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
 7. All text shall be searchable.
 8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.
- C. Paper Copy Submittal Procedures:
1. Once the electronic version of the manuals has been approved by the Architect/Engineer, two (2) paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
 2. Binder Requirements: The Contractor shall submit three sets of O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are **not** acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2"12mm thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
 3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
 4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.
- D. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
 2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
 3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
 4. Copy of final approved test and balance reports.
 5. Copies of all factory inspections and/or equipment startup reports.
 6. Copies of warranties.
 7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
 8. Dimensional drawings of equipment.
 9. Capacities and utility consumption of equipment.

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10. Detailed parts lists with lists of suppliers.
 11. Operating procedures for each system.
 12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
 13. Repair procedures for major components.
 14. List of lubricants in all equipment and recommended frequency of lubrication.
 15. Instruction books, cards, and manuals furnished with the equipment.

3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.
- E. Refer to the individual specification sections for minimum hours of instruction time for each system.
- F. Operating Instructions:
 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the security systems.
 2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.7 SYSTEM COMMISSIONING

- A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.8 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
- C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.
- E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.9 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

3.10 CONSTRUCTION WASTE MANAGEMENT

- A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as referenced in these specifications).
 - 1. This Contractor shall coordinate with the General Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled.
 - 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process for all materials associated with this Contractor's scope of work. The Contractor shall provide this information to the General Contractor so that it can be incorporated with similar information from all other contractors for the project.
 - a. Calculations for waste and recycled material can be done by weight or volume, but they must be consistent throughout the project. The Contractor shall coordinate with the General Contractor to establish the preferred calculation method and report the results accordingly.
 - b. Excavated soil and land-clearing debris do not count towards the waste disposal or recycled material.

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3. At a minimum, 50% 75% of the construction and demolition debris for this project must be recycled or salvaged.

END OF SECTION 28 05 00

SECTION 28 13 00 - ACCESS CONTROL SYSTEM (KEYSCAN)

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PART 1 - GENERAL

1.1. SUMMARY

- A. The City of Madison Information Technology Department has been assisting other City agencies with standardizing facilities through the use of access cards, key fobs, and punch pads. All hardware is installed locally at the facility while software controls access to various doors remotely.
- B. These specifications describe the materials, equipment, and installation requirements to install an integrated, computerized access control and alarm monitoring system utilized by the City of Madison Information Technology (CoM-IT) Department.
- C. The ACS System Contractor shall be responsible for verifying equipment requirements, locations, and coordination with the General Contractor and all other necessary trades as needed for a complete installation.

1.2. RELATED SPECIFICATIONS

- A. 01 31 23 Project Management Web Site
- B. 01 33 23 Submittals
- C. 08 71 00 Door Hardware
- D. 27 05 00 Basic Communication Systems Requirements

1.3. RELATED DRAWINGS

- A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line voltage locations.
- B. Refer to all Technical drawings for locations of Access Control System (Keyscan) equipment.
- C. Refer to the door hardware schedule and Architectural floor plans for information relating to door access locations and specific hardware requirements.

1.4. REFERENCES

- A. The system shall comply with the standards, codes and regulations of the following regulatory bodies:
 - 1. Underwriters Laboratories (UL) Std No. 294 – Access Control System Units
 - 2. Canadian Standards Association (CSA) Std C22.2 No. 205-M1983 – Signal Equipment
 - 3. CE Standards
 - a. EN 55022 RF Emissions
 - b. EN 55024 RF Immunity

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- c. EN 60950-1 Equipment Safety
 - 4. FCC Subpart B – RF Emissions
 - 5. Industry Canada ICES 003 Emissions
 - 6. RoHS

1.5. CONTRACTORS QUALIFICATIONS

- A. The Contractor installing the ACS system shall:
 - 1. Be a Certified Keyscan Enterprise Partner
 - 2. Utilize installers who are Keyscan Enterprise Certified Technicians
 - 3. Be based within 25 radial miles of the project location
 - 4. Be able to provide 24/7/365 support during the warranty period of this project
 - 5. Be able to respond and repair or replace most components within 4 hours of notification

1.6. SUBMITTALS

- A. The Contractor shall provide a complete submittal package in a timely manner to allow sufficient review time prior to ordering the system components required for a complete installation. The contractor shall be solely responsible for any equipment, purchased/ordered/delivered that is not approved of during the submittal review process.
- B. The complete submittal package shall include but not be limited to the following:
 - 1. All certifications of the contractor and contractor's installation team. Certifications shall be current from the start of the contract through the end of the warranty period.
 - 2. Cut sheets indicating, shop drawings, performance data, and other such information that will indicate the component being installed matches the component that was specified.
 - 3. Cut sheets and shop drawing of Contractors recommendations for tags and labels.

1.7. WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
 - 1. The Contractors warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

1.8. QUALITY ASURANCE

- A. The Contractor shall be responsible for coordinating his/her Work with other trades and divisions as needed for a complete installation. This shall include pre-installation meetings for locating equipment, conduit, cabling, control devices, and other materials and equipment required by this installation.
- B. The General Contractor (GC) shall be responsible for ensuring that all doors requiring controlled access are properly prepared and installed per the contract documents. The GC shall further be responsible for ensuring all project coordination, pre-installation meetings, submittals and other such project management responsibilities are conducted efficiently and according to the project specifications and schedules.

PART 2 - PRODUCTS

2.1. SYSTEM PRODUCTS OVERVIEW

- A. The City of Madison Information Technology Department (CoM IT) owns and operates a fully licensed copy of the Keyscan Access Control System software.
 - 1. The Keyscan Access Control System (ACS) provides controlled access to secured doors through the use of electronic door latches, proximity readers, control panels, and a proprietary software program.
 - 2. The Keyscan software allows CoM-IT and the facility the Owner to customize multiple levels of access and system performance through any combination of the following:
 - a. Calendar and time based lock/unlock controls

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- b. Group access control for common personnel groups
 - c. Individual access control for specialized access control
 - d. Temporarily disable access control for a specified time period
 - e. Remotely unlock/lock a door
 - f. Lockdown a facility from one location
 - g. Provide customizable alert notifications

2.2. EQUIPMENT AND COMPONENTS

- A. The Contractor guarantees that all equipment and components shall be furnished new, undamaged, free of defects, and conform to the drawings and specifications of this contract. The contractor is solely responsible for replacing any damaged or defective item.
- B. New ACS components on interior and exterior access doors shall be able to be integrated with the Owners existing Keyscan system.

2.3. DISTRIBUTION SUPPLY PANEL (AC-DS-1)

- A. AC-DS-1 brings line voltage into the ACS system with the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 1.45A
 - 2. Output
 - a. Eight (8) PTC protected outputs
 - b. 16VAC output
 - c. 16VAC @ 10amp (175 VA) supply current (1.25 amp per device, 2.5 amp max.)
 - d. Outputs rated @ 2.5 amp
 - e. Main fuse rated @ 15 amp/32V
 - f. Surge suppression
 - 3. Miscellaneous electrical information
 - a. Operating temperature 0° C to 49°C ambient
 - b. 81.89 BTU/hr
 - c. System AC input VA requirement 166.75 AV
 - 4. Miscellaneous required features
 - a. AC power LED indicators
 - b. Illuminated master power disconnect circuit breaker with manual reset
 - 5. Agency Approvals
 - a. UL 294 listed for Access Control System Units
 - b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
- B. AC-DS-1 shall be:
 - 1. Altronix, AL168175CB
 - 2. Pre-approved equal

2.4. POWER SUPPLY PANEL (AC-PS-1)

- A. The AC-PS-1 brings line voltage from the AC-DS-1, reduces then distributes the voltage to the Access Security Panels (AC-SEC-1) with the following performance specifications:
 - 1. Input
 - a. 115VAC, 60Hz, 1.9A
 - b. Power supply input options
 - i. One (1) common power input for ACM8 and lock power (factory installed)
 - ii. Two (2) isolated power inputs; one (1) to power the ACM8 and one (1) for lock accessory power, (external power supply is required). Current is determined by the power supply connected, not to exceed a maximum of 10 amp total
 - c. Eight (8) Access control System trigger inputs with the following options:
 - i. Eight (8) normally open (NO) inputs
 - ii. Eight (8) open collector inputs
 - iii. Any combination of the above
 - 2. Output
 - a. 12VDC or 24VDC @ 6 amp supply current
 - b. Eight (8) independently controlled outputs with the following options:
 - i. Eight (8) Fail-Safe and/or Fail-Secure power outputs
 - ii. Eight (8) form "C" 5 amp rated relay outputs

- iii. Any combination of the above
 - c. Eight (8) auxiliary power outputs (un-switched)
 - d. Output fuses rated @ 3.5 amp
 - e. Filtered and electronically regulated outputs (built-in power supply).
 - 3. Miscellaneous electrical information
 - a. Operating temperature 0° C to 49°C ambient
 - b. BTU/hr:
 - i. 12VDC = 36.85 BTU/hr
 - ii. 24VDC = 73.70 BTU/hr
 - c. ACM8 board main fuse is rated at 10 amp
 - 4. Battery Backup
 - a. Built-in charger for sealed lead acid or gel type batteries
 - b. Power supply board maximum charge current 0.7 amp
 - c. Automatic switch over to stand-by battery when AC fails
 - d. Zero voltage drop when unit switches over to battery backup (AC failure condition)
 - e. Battery fail and battery presence supervision (form "C" contact)
 - 5. Miscellaneous required features
 - a. Fire Alarm disconnect (latching or non-latching) is individually selectable for any or all of the eight (8) outputs.
 - b. Fire Alarm disconnect input options:
 - i. Normally open (NO) or normally closed (NC) dry contact input
 - ii. Polarity reversal input for FACP signaling circuit
 - c. Alarm output relay indicates that FACP input is triggered (form "C" contact rated @ 1 amp 28VDC)
 - d. Short circuit and thermal overload protection
 - e. AC fail supervision (form "C" contact)
 - f. Red LEDs indicate outputs are triggered (relays energized)
 - g. Green LED indicates FACP disconnect is triggered
 - h. AC input and DC output LED indicators
 - i. Enclosure accommodates up to two (2) 12AH batteries
 - 6. Agency Approvals
 - a. UL 294 listed for Access Control System Units
 - b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
 - B. AC-PS-1 shall be:
 - 1. Altronix, AL600ULACM
 - 2. Pre-approved equal
- 2.5. SECURITY PANEL (AC-SEC-1)
 - A. The AC-SEC-1 distributes the reduced voltage and control wiring to/from each door with an access control device.
 - B. AC-SEC-1 shall be:
 - 1. Keyscan CA8500 – 8 Reader Access Control Panel
 - C. The AC-SEC-1 shall be provided, located and mounted by the Contractor in room B001A (MC-1).
- 2.6. DOOR CONTROL DEVICES
 - A. The Contractor shall be responsible for verifying the Door Control Device (DCD) quantities and locations with the door hardware schedule.
 - B. DCD shall be:
 - 1. Keyscan K-KPR – Keyscan Proximity Reader/Keypad, this reader accepts swipe monitoring of cards, key fobs, and other such devices as well as accepting personal identification numbers (PINs)
 - i. Plan designation = AC-CR1-W
 - 2. Nedap UPASS reach microwave RFID device
 - i. Plan designation = AC-CR3-W
 - 3. Provide UHF windshield tags, quantity per Owner requirement for bid purposes provide 100
- 2.7. DOOR CONTROL CABLES
 - A. The following cables are required for a complete installation of the ACS, per controlled door, as follows:
 - 1. One (1) 22/6 shielded cable, required; to DCD
 - 2. One (1) 18/2 un-shielded cable, required; lock power

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3. One (1) 22/2 un-shielded cable, required; door contact
 4. One (1) 22/4 un-shielded cable, required but not used; for future request to exit sensors
- B. At the Contractor's option he/she may run a manufactured cable bundle containing all four (4) cables listed above. It shall be the sole responsibility of the contractor to appropriately size the conduits for the installation.

PART 3 - EXECUTION

3.1. COOPERATION OF THE ACS CONTRACTOR

- A. The Contractor shall be required to coordinate with all trades for a complete and timely installation. This includes attending all pre-installation meetings where equipment locations, conduit locations, and control devices will be installed or may be in conflict with the installation of other trades. The Contractor shall be solely responsible for any additional cost required for removing/replacing/modifying any completed work by other trades because the installation was not properly coordinated.
- B. The Contractor shall coordinate with the Owner's Representative from City IT for all information necessary to complete the installation and integration with the Owner's existing hardware and software.
- C. The Contractor shall verify with the appropriate Owner's Representative for mounting heights of all hardware and equipment prior to installation. This shall be completed at a pre-installation walk through prior to rough-in.
- D. The Contractor shall coordinate with the Owner's Representative from City IT to verify all requirements for all access controlled doors are properly coordinated and understood prior to roughing in the installation.

3.2. GENERAL EQUIPMENT MOUNTING

- A. All ACS equipment shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the General Contractor. Contractor shall tape out all equipment prior to mounting to insure adequate space is allotted for the complete installation per the riser diagrams including all related conduits and cables.
- B. All equipment shall be neatly arranged so as to meet or exceed the manufacturer's recommended working space around each component.
- C. Equipment to be installed on plywood mounting panels shall include but not be limited to the following:
 1. Distribution Service Panel (AC-DS-1)
 2. Power Supply Panel (AC-PS-1)
 3. Access Control Panel (AC-SEC-1)
 4. All required conduits, and boxes for line voltage

3.3. GENERAL CONDUITS AND WIRING

- A. This section shall apply to both the ACS Contractor and the Electrical Contractor. The following division of responsibilities shall apply:
 1. The Electrical Contractor shall be responsible for furnishing, installing, and connecting all conduits, connectors, conductors, and other related materials associated with providing line voltage to the ACS system as follows:
 - a. Providing an 110V, 15A, dedicated circuit from the designated distribution panel to AC-DS-1 as described in Section 2.3 above.
 - b. Providing line voltage from AC-DS-1 to AC-PS-1 as described in Section 2.4 above.
 2. The ACS Contractor shall be responsible for furnishing installing, and connecting all conduits, connectors, conductors and other related materials required to complete the installation of the low voltage wiring and door controller cabling.
- B. All conduits shall be properly sized for the number of wires or wire bundles being pulled through the conduit. The Contractor shall verify with the manufacturer the recommended fill rate by conduit size and shall not exceed the recommendations.
- C. The contractor shall neatly lay out all conduits in such a fashion so as to minimize bending, crossovers, etc.
- D. Bends, pull boxes, and pull points shall be sized and located as per all applicable codes and standards for the number of wires or wire bundles in the bend, pull box, pull point.
- E. CAT6 cables from each AC-SEC-1 shall be neatly run in cable management equipment supplied and installed by the cabling contractor or conduits supplied and installed by the ACS Contractor as needed. The switch to be used for all ACS equipment shall be located in Telecom Room B001A. Cables shall be labeled on both ends per the cabling specification.
- F. The General Contractor and the ACS Contractor shall ensure the following Emergency Access requirements are properly installed and operational prior to the final Madison Fire Department inspection for occupancy.
 1. CoM IT shall provide a minimum of six (6) swipe cards to each installed Knox Box for emergency entrance. The cards shall be appropriately coded for entry at all controlled access doors.

3.4. EQUIPMENT IDENTIFICATION AND LABELING

- A. The Contractor shall provide and install all equipment identification and labeling to the following specifications.
 - 1. Tags and labels shall be permanent rigid plastic or metal tags with engraved or machine stamped lettering. Hand written self-stick or metal hand stamped tags will not be accepted.
 - 2. The Contractor shall work out the labeling scheme for doors with City IT, Owner, and Architect prior to ordering any labels or tags.
 - 3. The Contractor shall provide all labels and tags associated with this specification. This shall include the line voltage feed to each AC-DS-1 from the electrical distribution panel.
- B. Panels and Boxes
 - 1. All panels and boxes shall be labeled on the outside cover that readily identifies the panel/box as a "Distribution Supply", "Power Supply", "Access Control Panel", etc. An associated number shall also be on each tag and the number "1" shall be used even if there is only one of that type panel/box.
 - 2. Access Control Panels shall have a card index inside the front cover of each door indicating the controller number, door number, and door location being served by that panel.
- C. Conduits
 - 1. Line voltage from electrical distribution panels shall have conduits labeled on both ends as follows:
 - a. At the distribution panel the line voltage conduit shall be labeled with the system supplied, and the ACS distribution supply panel number.
 - b. In the Telecommunications Room the line voltage conduit label shall indicate the distribution panel and circuit number(s) controlling the supply line.
 - 2. Conduits between Access Control Panels and the controlled doors shall be labeled on both ends as follows:
 - a. In the Telecommunications Room each conduit shall be labeled with the door number(s) being supplied.
 - b. Above the finished ceiling where the conduit is exposed prior to going into the wall space that serves the door the conduit shall be labeled with the Door Control Panel and Controller number associated with the door being served.
 - c. If the conduit size is reduced as control cabling is supplied to doors along the run each change in conduit size shall be re-labeled as noted in 2.b. above.
 - 3. Conduits between equipment and components in the Telecommunications Room do not need to be identified.

3.5. INSTALLATION TESTING AND ACCEPTANCE

- A. The CoM IT and the Owner shall be responsible for completing all software programming associated with the installation of this contract prior to the completion of the installation of the system components. It is the sole responsibility of the Contractor to notify the Owner no less than two (2) weeks in advance of completing the installation that all codes and time setting shall be prepared for final installation and testing.
- B. The Contractor, CoM IT, and the Owner shall test each access control point with swipe cards and PINs to insure the door unlocks.
- C. CoM IT shall test each door using the existing fully integrated software. This shall include but not be limited to the following:
 - 1. Remotely lock/unlock the doors
 - 2. Verify time clock feature works for locking doors
 - 3. Verify swipe cards and PINs work on all doors
 - 4. Verify emergency entrance cards for knock boxes work on all doors for the areas served.
- D. A completed and accepted installation shall pass all of the above tests for all controlled access points.
- E. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION 28 13 00

SECTION 28 20 00 - ELECTRONIC SURVEILLANCE

PART 1 – GENERAL 1

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PART 1 – GENERAL

1.1. SUMMARY

- A. The City of Madison requires video surveillance of interior and exterior areas of the Midtown Police Station as indicated in the Technology plan sheets.
- B. This specification shall identify major equipment components and accessories required for a complete video surveillance installation. It does not include materials such as cables, boxes, connectors, conduit, supports and other ancillary equipment required to complete the installation.
- C. For the purposes of this specification the term Contractor shall refer to the person(s) responsible for installing the Electronic Surveillance System and may or may not be the same contractor installing other Division 27 and 28 related equipment. Other contractors having related work shall be referred to by full title (Electrical Contractor).

1.2. RELATED SPECIFICATIONS

- A. 01 31 23 Project Management Web Site
- B. 01 33 23 Submittals
- C. 01 78 23 Operation and Maintenance Data
- D. 01 78 36 Warranties
- E. 01 78 39 As-Built drawings
- F. All Division 27 specifications that may apply to this installation

1.3. AREAS OF RESPONSIBILITY

- A. The General Contractor (GC) shall be responsible for ensuring all of the following:
 - 1. Coordinate all Contractor related work with the construction schedule.
 - 2. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and resolve installation issues as needed.
- B. The Contractor shall be responsible for all of the following:
 - 1. For all equipment ordering and purchasing, setup, configuration, and testing of equipment being installed under this specification and connected to City of Madison-Information Technology (CoM-IT) servers and equipment.
 - a. Include any mounting brackets required for mounting camera equipment to the structure.
 - b. The Contractor shall be responsible for the bridge supports identified in Section 2.2.C below.
 - 2. Verification of Owner installation requirements prior to installing equipment and accessories.
 - 3. Provide all ancillary materials and equipment required to complete the installation.
- C. CoM-IT shall be responsible for all of the following:
 - 1. The CoM-IT shall be responsible for the Exacq-Vision system licenses.
 - 2. Provide connection to servers and other hardware necessary to bring installed equipment on line.
 - 3. Assist in final testing of equipment and equipment functions installed under this specification.

1.4. SUBMITTALS

- A. The Contractor shall provide submittals of the following:

-
1. All applicable certifications and licenses of the Contractor and the Contractor's installation team. Applicable certifications and licenses shall be current from the start of the contract through the end of the warranty period.
 2. One (1) submittal for all ancillary Electronic Surveillance Contractor provided equipment required for a complete installation as follows:
 - a. Product information sheets and shop drawings indicating each type/size/model of Electronic Surveillance required for a complete installation. Information sheets shall include the following information:
 - i. Performance data for the item
 - ii. Plan identification number(s) where applicable
 - iii. Quantity required for each model

1.4. WARRANTY

- A. The Contractor shall warrant for one year the complete installation of equipment and components associated with this contract and installation. Contractors warranty shall be in the form of a written letter on company letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized representative of the Contractors Company.
 1. The Contractors warranty shall include but not be limited to the following:
 - a. Transportation to and from the location as often as needed during the warranty period.
 - b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
 - c. All fees associated with the shipping of any component that needs to be returned or supplied by the manufacturer for repair or replacement.
 - d. All labor and materials required to remove, repair, replace, or re-install of any component.
- B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components of the completed installation.

PART 2 - PRODUCTS

2.1. EXTERIOR SURVEILLANCE LOCATIONS

- A. The exterior camera shall be a high quality outdoor ready PTZ (pan/tilt/zoom) camera as follows:
 1. AXIS Communications, PTZ Dome Network Camera with the minimum requirements listed below:
 - a. HDTV minimum 1920 x 1080p
 - b. Certified compatible with Exacq Technologies Exacq-Vision Video Management System
 - c. 3 year AXIS extended warranty option
- B. Exterior camera mounting accessories shall of high quality and rated for outdoor environments.
 1. AXIS Communications, models as required for the installation of the above noted camera and locations as indicated in the plans and specifications, any substitutions in camera placement to be reviewed and approved by City of Madison Department of Information Technology, with all standard features including the following:
 - a. 3 year AXIS extended warranty option

2.2. INTERIOR SURVEILLANCE LOCATIONS

- A. The interior camera shall be a high quality indoor ready PTZ (pan/tilt/zoom) camera as follows:
 1. AXIS Communications, PTZ Dome Network Camera with the minimum requirements listed below:
 - a. HDTV minimum 1920 x 1080p
 - b. Certified compatible with Exacq Technologies Exacq-Vision Video Management System
 - c. 3 year AXIS extended warranty option
- B. Interior camera mounting accessories shall of high quality and rated for indoor environments,
 1. AXIS Communications, models as required for the installation of the above noted camera and locations as indicated in the plans and specifications, any substitutions in camera placement to be reviewed and approved by City of Madison Department of Information Technology, with all standard features including the following:
 - a. 3 year AXIS extended warranty option
 - b. Surface mount as per plans
 - c. Drop ceiling mount as per plans
- C. All drop ceiling mount locations shall include tile bridge supports
 1. ERICO, SCMKC Security Camera Mounting Kit
 2. Pre-approved equal

PART 3 - EXECUTION

3.1. COOPERATION OF THE CONTRACTOR

- A. All line voltage installations that may be required under this specification shall be installed by the Electrical Contractor. Power shall come from the nearest power panel where the equipment is being installed. Label boxes with panel and circuit number for future reference. Installation shall include any fire stopping as required by code.
- B. Data cables shall be installed by the Cabling Contractor as required for this installation. Data cables shall come from the nearest Telecom Room where the equipment is being installed. Installation shall include any fire stopping as required by code.
- C. The Contractor shall install all security cameras, mounting hardware, boxes and other equipment necessary for a complete installation of the surveillance system.

3.2. EXTERIOR INSTALLATIONS

- A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong, secure and stable installation as necessary for the building materials being mounted to.
- B. Provide and install a high grade clear silicone sealant around all mounting hardware.
- C. Provide sufficient cable and install a drip loop if cable is exposed outside of the mounting hardware.
- D. Label camera end of data cable with permanent data tag indicating switch location connection id.
- E. Label switch end of data cable with permanent data tag indicating camera location.

3.3. INTERIOR INSTALLATIONS

- A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong, secure and stable installation as necessary for the building materials being mounted to.
- B. Install tile bridge supports at all drop ceiling locations.
- C. Label camera end of data cable with permanent data tag indicating switch location connection id.
- D. Label switch end of data cable with permanent data tag indicating camera location.

3.4. INSTALLATION TESTING AND ACCEPTANCE

- A. Any required system programming (by Contractor) shall be completed prior to doing any installation testing and acceptance.
- B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of completing the installation to coordinate all final testing of the completed system.
- C. The Contractor and CoM-IT shall test each surveillance camera installation to ensure the installed components work per the specifications.
 - 1. All installed components shall be inspected as follows:
 - a. All connections are tight, exterior installations are weather proof with clear silicone sealant.
 - b. All components are clean and free of dust, finger prints and other general dirt.
 - c. Camera lenses and domes are clean and free of lint, dust and finger prints.
 - d. Cameras are free to rotate.
 - e. All network connectivity is complete and installed properly.
 - 2. Each camera installation at the project site shall be tested from an offsite computer to ensure all pan/tilt/zoom features, focus and other functions are fully operational.
- E. A completed and accepted installation shall pass all of the above tests for each installed camera location.
- F. The warranty period for the completed and accepted installation shall not begin until the date of the accepted general contract. The Contractor shall coordinate this date with the General Contractor.

END OF SECTION 28 20 00

SECTION 28 31 00 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm and detection systems

1.2 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.
- B. Installer: A factory-authorized licensed electrical or security contractor with five years' experience in the design, installation and maintenance of fire alarm systems by that manufacturer.
- C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire Alarm Certified by NICET, minimum Level 2. This person's name and certification number shall appear on the start-up and testing reports.

1.3 REFERENCES

- A. ASME A17.1 - Safety Code for Elevators and Escalators
- B. NFPA 70 - National Electrical Code
- C. NFPA 72 - National Fire Alarm and Signaling Code
- D. NFPA 101 - Life Safety Code
- E. UL 2017 – General Purpose Signaling Devices and Systems

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 26 05 00 and as noted below.
 - 1. Failure to comply with all of the following and all of the provisions in 26 05 00 will result in the shop drawing submittal being rejected without review.
 - 2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive submittal will be grounds to require a complete resubmittal.
- B. Provide product catalog data sheets as shop drawings.
 - 1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for each piece of equipment that is not shown on the drawings, but required for the operation of the system.
 - 2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted by subscripts, etc.) a separate additional product catalog data sheet shall be provided for each variation that requires a different part number to be ordered. The corresponding Electrical Symbols List symbol shall be shown on the top of each sheet.
 - 3. Where multiple items and options are shown on one data sheet, the part number and options of the item to be used shall be clearly denoted.

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- C. Submit CAD floor plans as shop drawings:
 - 1. The complete layout of the entire system, device addresses, auxiliary equipment, and manufacturer's wiring requirements shall be shown.
 - 2. Indicate the precise routing of notification appliance circuits under the provisions of circuit survivability. Refer to "Wiring" under Part 3 - Execution of this specification section for requirements.
 - 3. A legend or key shall be provided to show which symbols shown on the submittal floor plans correspond with symbols shown on the Contract Documents.
 - D. With regard to all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type, size, etc.) and voltage drop calculations.
 - E. Provide installation and maintenance manuals under provisions of Section 26 05 00.
 - F. Submit manufacturer's certificate that system meets or exceeds specified requirements.
 - G. Provide information on the system batteries as follows: total battery capacity, total capacity used by all devices on this project, total available future capacity.
 - H. Voice Alarm Communication System: Submit equipment rack or console layout, grounding schematic, amplifier power calculations, and wiring diagram.
 - I. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and installation/testing.
 - J. When required to comply with local or state regulatory reviews, the fire alarm submittal shall have a Professional Engineer's stamp and signature of the state in which the project is completed. NOTE: The Architect/Engineer cannot stamp and seal submittal drawings not prepared under their supervision.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.
 - a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.
 - b. Notification appliances: Speakers, speaker strobes, and strobes.
 - 2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet [minimum of one (1) set each] and shall turn over to the Owner upon completion.
 - 3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 26 05 00.
- B. Store and protect products under provisions of Section 26 05 00.

1.7 REGULATORY REQUIREMENTS

- A. System: UL or FM Global listed.
- B. Conform to requirements of NFPA 101.
- C. Conform to requirements of Americans with Disabilities Act (ADA).
- D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.8 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, voice evacuation equipment, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.
- C. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.
- D. Voice Communication: The facility shall have an emergency voice alarm communication system. The digitized recorded voice message shall notify occupants that a fire condition has been reported. Emergency manual voice override shall be provided.
- E. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.
- F. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.
- G. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.
- H. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.9 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 26 05 00.
- B. Include location of end-of-line devices.
- C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.

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- D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 26 05 00.
- B. Include operating instructions, and maintenance and repair procedures.
- C. Include results of testing of all devices and functions.
- D. Include manufacturer's representative's letter stating that system is operational.
- E. Include the CAD floor plan drawings.
- F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.11 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Simplex
- B. Notifier by Honeywell
- C. Edwards - EST
- D. Siemens Fire Safety
- E. Gamewell - FCI

2.2 **[FAP-#]:** FIRE ALARM CONTROL PANEL (FAP)

- A. Control Panel: Modular, power-limited electronic design. Provide surface wall-mounted enclosure as shown on plans. Enclosure shall be minimum 0.060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.
- B. Each Signaling Line Circuit (SLC loop) shall not be loaded over 80% of the maximum device capacity. For example, in the minimum system capacity column listed below, if the fire alarm manufacturer's system capacity of analog sensors per loop is 99 devices, then no more than 79 devices shall be wired on that loop. The minimum system capacity shall be as follows:

Minimum Total Addressable Points:	500
Minimum Total SLC loops (including board, ready for field connections):	2

- C. Signal Line Circuit Board (SLC):
 - 1. Each board shall communicate directly with each addressable analog sensor and binary input to determine normal, alarm, or trouble conditions. Analog signals would be used for automatic test and determination of maintenance requirements.

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2. Each board shall contain its own microprocessor and shall be provided to monitor addressable inputs and to control addressable outputs (addressable relays). The board shall communicate and provide power to all devices on its loop over a single pair of wires, except where 4-wire devices require a separate power circuit.
 3. Class B, Style 4: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.
 4. SLC for addressable devices with less than 50 devices can be Class A or B, and more than 50 devices shall be Class A.
- D. Notification Appliance Circuit (NAC) Board:
1. Each board shall contain its own microprocessor and shall be provided to control each notification appliance circuit. The board shall communicate and provide power to all devices on its loop.
 2. Class B, Style Y: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.
- E. Central Processing Unit:
1. The central processing unit (CPU) shall communicate with the monitor and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the CPU.
 2. The CPU shall execute all control-by-event programs for specific action to be taken if a designated situation is detected in the system. A real-time system clock for time annotations on the display and printer shall be included.
 3. All power for the unit shall be supervised and supplied by the FAP.
- F. Display:
1. The board shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters.
 2. The board shall provide an alphanumeric array for display of custom alphanumeric labels for all addressable points. It shall also provide indicators for AC Power, System Alarm, System Trouble, Display Trouble and Signal Silence.
 3. Displayed descriptions of addressable points shall include actual room names/numbers selected by the Owner. This information shall be obtained prior to programming. Room names/numbers shown on floor plans shall not be used.
 4. The board shall provide a touch key-pad with control capability to command all system functions and entry of any alphanumeric information. Twenty different passwords with four levels of security shall be supported to prevent unauthorized manual control or programming.
- G. Memory: The CPU and display interface board shall be augmented by non-volatile field programmable memory. EPROM memory will also be allowed provided the memory is burned in with minimum expansion capability equal to the total system capacity of the panel. Memory shall not be lost upon primary and secondary power failure.
- H. Serial Interface Board: The board shall provide interfaces to a printer, LCD display and other monitoring devices through RS-232 connections. The minimum operational distance between the board and the peripheral devices shall be 500 feet. Up to three (3) RS-232 outputs shall be supported.

I. Power Supply:

1. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications and drawings. Each component of the fire alarm system requiring 120 VAC input power shall be served from a dedicated emergency branch circuit. Provide two #12 conductors and one #12 ground in 3/4" conduit to a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Identify/label breaker and branch circuit in accordance with NFPA requirements and Specification Section 26 05 53.
2. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Over-current protections shall be provided on all power outputs.
3. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.
4. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 15 minutes, plus 25% spare capacity for future devices.

J. Surge Protection:

1. All fire alarm control panels, NAC panels, etc. shall be provided with a surge protection device (SPD). The SPD shall be UL listed to Standard 1449 Rev 3. The unit should be clearly labeled in accordance with Identification Section 26 05 53. The SPD shall have thermal fuses to protect against fire in short circuit conditions. The unit shall provide visual indication that the unit is protecting and functioning.
2. Any communications or signaling circuits associated with the fire alarm system, which leave or enter a facility, shall be provided with a surge protection device. The devices shall be as recommended by the fire alarm system manufacturer.

K. Digital Communicator:

1. Provide dual phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator shall report in SIA and most major communication formats, with the capability of transmitting each device address point in a format compatible with the central station receiver.
2. Communicator shall be fully supervised and shall operate on loop start phase lines ahead of the building PBX system.
3. Communicator shall be FCC registered. Contractor shall provide two RJ31X jacks.
4. Approvals: UL listed - UL 864/NFPA 72, FM approved.
5. The communicator shall be provided integral to the fire alarm panel as furnished by the fire alarm panel manufacturer. If the panel construction requires a separate unit, the unit shall be as manufactured by Silent Knight, Ademco, or fire alarm panel manufacturer approved equal.

L. IP-GSM Digital Cellular Fire Communicator:

1. Provide digital internet / cellular phone interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Monitoring fees and initial connection charges are not part of this project.
2. Contractor to provide connection of communicator to Owner's Ethernet 10/100 Base network connection. Wiring shall be in 1" conduit.

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3. Communicator shall convert fire alarm control panel phone outputs into Ethernet packets and transmit to GSM networks in area including 2G, 3G and 4G.
 4. Communication shall include system status including individual addressable device status, power loss, low battery and earth fault, and 24 hour test signal.

M. **[VCC-#]:** Digitized Voice Command Center (VCC):

1. The Digitized Voice Command Center (VCC) shall contain all equipment required for all audio control, signaling, and supervisory functions. This shall include digital voice units, speaker zone indication, and microphones.
2. Function: The Voice Command Center equipment shall perform the following functions:
 - a. Operate as a supervised single channel automatic digitized voice evacuation system with manual emergency voice communication system.
 - b. Audibly and visually annunciate the active or trouble condition of every signal circuit.
 - c. Audibly and visually annunciate any trouble condition of tone generators and digital voice units required for normal operation of the system.
 - d. Provide all-call activities through activation of a single control switch.
 - e. Provide automatic, digitally recorded voice messages and tones.
3. Audio Amplifiers:
 - a. The audio amplifiers will provide a single channel audio power at 25/70 volts RMS for distribution to speaker circuits.
 - b. The audio amplifier shall include an integral power supply, and shall provide the following controls and indicators:
 - 1) Normal Audio Level LED
 - 2) Incorrect Audio Level LED
 - 3) Battery Trouble LED
 - 4) Amplifier Trouble LED
 - 5) Audio Amplifier Gain Adjust
 - c. Includes audio input and amplified output supervision backup input.
4. Audio Message Generator (Digitized Voice):
 - a. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a digitized voice message to all speakers in the building.
 - b. Actuation of any alarm initiating device shall cause a digitized message to sound over the speakers. The message shall be repeated four (4) times.
 - c. A built-in microphone shall be provided to allow paging through speaker circuits.
 - d. The audio message generator shall have the following controls and indicators to allow for proper operator understanding and control:
 - 1) All Call LED
 - 2) On-Line LED
 - 3) All Call Switch

5. Voice Messages:

- a. A pre-programmed custom digital voice message shall be used for notification appliance speaker circuits. The messages shall be approved by the Authority Having Jurisdiction (AHJ). Voice messages shall be from a female voice. The messages shall be provided in the multi-lingual language of the predominant building population.
- b. Message shall be preceded by a tone and message shall be repeated four times until silenced.
- c. Messages shall be annunciated by a single channel in all evacuation signal zones throughout the building.
- d. Message shall be as shown in the following table. These messages are not intended to specify the exact wording required, but to specify the minimum information conveyed by the message:

Alarm Type	NAC Area	Preceding Tone	Message
Fire Alarm	Single Channel-all areas	Three Chimes	May I have your attention please? A fire emergency has been reported in the building. Proceed calmly to the nearest exit and leave the building immediately. Do not use the elevators. Use stairwells where necessary.
Test	All areas	One Chime	"May I have your attention please? May I have your attention please? This is a test of the building emergency alarm system. This is only a test."
All Clear	All areas	One Chime	"May I have your attention please? May I have your attention please? The reported emergency has been investigated and normal conditions have been restored. You may return to all areas of the building."
Severe Weather	All areas	Wail	"May I have your attention please? May I have your attention please? A severe weather warning has been received. Please walk to the nearest designated safe area. Stay away from windows and glass. Do not use the elevators."
Homeland Security Warning	All areas	Wail	[Custom Message]
Custom Message	All areas	Wail	[Custom Message]

6. Speaker Circuit Control Switches/Indicators:

- a. Buttons shall be provided on the voice command center to manually activate all auxiliary messages. (i.e. all clear, severe weather, homeland security warning, custom message)

2.3 SIGNALING LINE CIRCUIT DEVICES

A. [FA-120]: Smoke Detectors:

- 1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
- 2. Each smoke detector shall connect directly to an SLC loop.
- 3. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.

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4. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
 5. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.
 6. A test means shall be provided to simulate an alarm condition.
 7. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.
 8. Audible sounder detector base for sleeping room applications:
 - a. The audible base shall sound an alarm in the local room in UL2017 operation and UL484 for general evacuation. The unit shall be programmable by the main control panel for the duration of operation.
 - b. The audible sounder base shall sound Temporal 3 (fire) or Temporal 4 (CO alarm) and be at 75 dB at 10 feet.
 9. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator Recall, S=Sleeping/Patient Room, D=HVAC Control, A=Atrium, SW=Stairwell, CR=Computer Room, SD=Smoke Dampers, DH=Door Hold Release, FD= Fire Door Release, MP=Medical Procedure Room.

B. [FA-121]: Projected Beam Type Detectors:

1. This device shall utilize photoelectric analog smoke sensor technology. Provide with transmitter and associated receiver. Microprocessor-based detector shall provide a minimum of eight sensitivity levels, temperature and dirt compensation, and automatic gain control. Sensor to contain beam alignment adjustments and receiver calibration.
2. Detector shall connect directly to an SLC loop or shall be provided with multiple monitor modules, as required, to connect to the SLC loop and for monitoring alarm and trouble output contacts. The detector shall be provided complete with all mounting hardware provided and installed where indicated on the drawings.
3. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided.
4. Provide with remote indicator panel providing LED indications of alarm and trouble.

C. [FA-122]: Duct Smoke Detectors:

1. Duct-type smoke detectors shall use the same analog photoelectric sensor technology, with the same features specified for standard smoke detectors, except with additional features as specified below.
2. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Where the detector housing is larger than the duct height, the Contractor shall fabricate a mounting bracket for the detector and attach according to the fire alarm manufacturer's recommendations.
3. Provide a remote alarm LED indicator device (FA-240/241) if detector is not visible from a floor-standing position. If detector is located above a suspended ceiling, mount remote indicator in ceiling directly below detector with a white single-gang faceplate labeled: Duct Smoke Detector.

D. **[FA-123]** In-Duct Smoke Detectors:

1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
2. Low Flow Type: Listed for use in duct with 0-2000 feet per minute velocity.
3. Each smoke detector shall connect directly to an SLC loop.
4. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided to match the duct application. Provide a two-piece head/base design.
5. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
6. Provide a remote LED indicator device (FA-240/241), mounted in ceiling directly below detector with a single-gang faceplate labeled: Duct Smoke Detector.

E. Manual Pull Stations:

1. Manual stations shall match the description on the drawings (refer to the General Electrical Equipment Schedule). The stations shall be mounted where shown on the drawings and be provided with all necessary mounting hardware. Use surface mount only on precast concrete or structure.
2. **[FA-130]**: Addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering.
3. **[FA-131]**: Addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Provide device with clear Lexan tamper resistant cover with integral 9V battery powered alarm that sounds when shield is lifted.
4. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.
5. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location, with maintained temperatures between 32°F and 120°F.

F. Heat Detectors:

1. **[FA-140]**: Combination rate of rise and 135°F fixed temperature analog thermal type sensor. Factory programmed to alarm at 135°F and at 15°F per minute rate-of-rise. Sensor shall measure heat level and send data to the control panel representing the analog level of thermal measurement and rate-of-rise.
 - a. A subscript is used to identify the device with a specific sequence of operation as follows:
E=Elevator Shutdown.
2. **[FA-141]**: 200°F fixed temperature. Provide a remote addressable monitor module to interface with addressable system as shown on the plans.
3. **[FA-142]**: Explosion-proof. Combination rate of rise and 135°F fixed temperature. Non-current carrying metal enclosure. Provide a remote addressable monitor module to interface with addressable system as shown on the plans.

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4. Provide a two-piece head/base design, with a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
 5. Heat detectors shall connect directly to SLC loops. Where fixed temperature or explosion proof detectors are used, one monitor module may be used to monitor all detectors in one room/area as shown on the drawings.
 6. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided.
 7. Provide a remote LED indicator device if detector is not visible from a floor-standing position.
 8. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. A connection for attachment of a remote indicator shall be provided.
 9. A test means shall be provided to simulate an alarm condition.
 10. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32°F and 120°F.
- G. **[FA-150]:** Carbon Monoxide/Heat/Smoke Combination Detector:
1. Multi-criteria sensor for photoelectrical smoke sensing, heat and carbon monoxide (CO) detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 2. The combined photoelectric smoke detection/heat/CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.
 3. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.
 4. The detector shall use only one address on the SLC.
 5. CO sensor cartridge element shall be field replaceable.
- H. **[FA-160]:** Monitor Modules:
1. Monitor Module shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit. It shall interface initiating devices with the control panel using Style D or Style B circuits. Contractor option: Use an interface module (2-wire operation) for Style B circuits connected to normally-open dry contacts, such as a flow switch.
 2. The module shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being monitored, or where shown on the drawings. All mounting hardware shall be provided.
 3. The module shall supply the required power to operate the monitored device(s).
 4. The module shall provide address setting means using rotary decimal or DIP switches.

I. **[FA-161]:** Addressable Relays:

1. Relay that represents an addressable control point used primarily for the control of auxiliary devices as indicated on the drawings. Contractor to provide additional slave relay(s), as required, rated for the electrical load being controlled (contractor to match voltage, amps, etc.).
2. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.
3. The relay shall be mounted in an enclosure located in an accessible service location as near as possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting hardware shall be provided.
4. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated on the drawings.

2.4 NOTIFICATION APPLIANCE DEVICES

A. Device Color:

1. Wall Mounted: Red housing with white lettering or pictogram.
2. Ceiling Mounted: Red housing with white lettering or pictogram.
3. WG subscript indicates wire guard is required.

B. Visual Alarm Devices:

1. **[FA-200]:** Wall mounted.
2. **[FA-201]:** Ceiling mounted.
3. High intensity (candela rating as scheduled on the drawings) xenon strobe or equivalent under a lens. Candela rating shall be visible from exterior of the device.
 - a. Candela Ratings: V1=15, V3=30, V7=75, VH=110, VS=177.
4. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.
5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.

C. **[FA-210]:** Audio (Speaker) Alarm Devices - Wall Mounted:

1. Sound rating shall be dependent on the tap (wattage) setting. Tap settings shall be available in 3 dBA increments. A minimum of four (4) tap settings should be available to allow field adjustment of the sound output across a minimum range of 78 to 87 dBA, 400Hz to 4KHz (6 dBA cutoff) frequency range.
2. Speakers shall operate on a 25V RMS system, unless otherwise noted on drawings.
3. Speakers shall clearly reproduce a signal consisting of a live or prerecorded human voice with voice intelligibility.
4. Speaker, housing, and backbox shall be UL listed for fire alarm/emergency applications.

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- D. **[FA-230]:** Audio (Speaker) Alarm Devices - Ceiling Mounted:
1. 4" speaker, round housing, flush mounted (provide tile bridge where applicable).
 2. Sound rating shall be dependent on the tap (wattage) setting. Tap settings shall be available in 3 dBA increments. A minimum of four (4) tap settings should be available to allow field adjustment of the sound output across a minimum range of 78 to 87 dBA, 400Hz to 4KHz (6 dBA cutoff) frequency range. Speakers shall operate on a 25V RMS system, unless otherwise noted on drawings.
 3. Speakers shall clearly reproduce a signal consisting of a live or prerecorded human voice and background music with voice intelligibility.
 4. Speaker, housing, and backbox shall be UL listed for fire alarm/emergency applications.
- E. Combination Audio (Voice) and Visual Notification Device:
1. **[FA-211]:** Wall mounted.
 2. **[FA-231]:** Ceiling mounted.
 3. Combine speaker and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.
- F. **[FA-203]:** Weatherproof Visual Notification Device:
1. High intensity strobe, square housing, 75 candela rating, suitable for wet locations. Provide with weatherproof back box.
 2. Mounting: Semi-flush wall.
 3. Conduit shall not be exposed.
- G. **[FA-212]:** Weatherproof Audio/Visual Notification Device:
1. Electronic horn with high intensity strobe, square housing, 75 candela, suitable for wet locations. Provide with weatherproof back box.
 2. Mounting: Semi-flush wall.
 3. Conduit shall not be exposed.
- H. **[FA-233]:** Mini-Horn Audio Notification Device:
1. Electronic horn.
 2. Mounting: single-gang flush wall.
- I. **[FA-212]:** Weatherproof Voice/Visual Notification Device:
1. Speaker with high intensity 75 candela rated strobe. 25 VRMS with a minimum of four (4) tap settings which shall allow field adjustment of the sound output across a minimum range of 78 to 87 dBA (UL 1480), 400 Hz to 4 KHz (6dBA cutoff) frequency range.
 2. Mounting: Semi-flush wall.
 3. Conduit shall not be exposed.

2.5 DOOR HOLD-OPEN DEVICES

A. **[FA-270]:** Electromagnetic Door Holder Devices:

1. Flush wall mounted Surface wall mounted Floor mounted.
2. Voltage: 120V.
3. Holding force shall be 25 pounds minimum.
4. Provide fail-safe operation; power failure releases door.
5. Provide self-adjusting swivel catch plate with pivot points to adjust to door alignment changes.
6. Provide all hardware and wiring needed to accommodate the complete functioning door holder installation.
7. Ensure that the door hardware and trim projections are compatible with total projection of door release.
8. Provide firm anchoring for the electromagnet, such that the mounting box and device will not move independently from the wall or floor they are mounted to. This device and mounting will function as a doorstop and hold the force of the door closer mechanism.
9. Follow manufacturer's recommended installation and location instructions unless noted otherwise.
10. Electromagnetic door holder devices, housing, and back box shall be UL listed.

2.6 **[NEP-#]:** NAC EXTENDER PANELS (NEP)

- A. As shown on the plans or as a Contractor's option if not shown, furnish and install NAC extender panels as necessary to provide remote power supply for notification appliance circuits (NAC). Contractor shall indicate quantity and locations of each NEP on the shop drawing submittals.
- B. Each NEP shall be self-contained remote power supply with batteries, and battery charger mounted in a surface lockable cabinet. Battery capacity shall be sufficient for operation for 24 hours in a non-alarm state followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NEP provides a minimum of up to 4 outputs, 2A continuous, or 6A full load total capacity.
- C. Power for each NEP shall be from a local 120 VAC emergency circuit. Provide two #12 conductors and one #12 ground in 1/2" conduit to each NEP from a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Coordinate panel and circuit number with Architect/Engineer prior to installation.
- D. NAC extender panels may be installed only in locations coordinated with the Architect/Engineer.

2.7 ANNUNCIATION

A. **[FAA-#]:** Remote LCD Annunciators:

1. Auxiliary annunciators shall indicate alarm and trouble conditions visually and audibly as shown on the drawings. Provide local TROUBLE ACKNOWLEDGE, TEST, and ALARM SILENCE capability. Minimum 80-character display.
2. Communications and power to the annunciators shall be supervised. The annunciator shall receive power from the fire alarm control panel.
3. A single key switch shall enable all switches on the annunciator.

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- B. Facility Management Control System (FMCS) Interface:
 - 1. Provide BACnet IP interface for fire alarm panel to communicate status with the FMCS. Provide list of points and descriptions to FMCS supplier.
 - a. UL listed to Standard 864. Provide RJ45 connection and cable.
 - C. **[FA-241]:** Fire Alarm Remote Indicator:
 - 1. Red LED type.
 - 2. Mounts flush to a single gang box.
 - D. **[FA-242]:** Fire Alarm Remote Indicator and Test Switch:
 - 1. Red LED type.
 - 2. Key switch test selector.
 - 3. Mounts flush to a single gang box.

2.8 CONNECTIONS TO AUXILIARY DEVICES PROVIDED BY OTHERS

- A. **[FA-250]:** Smoke Damper:
 - 1. Motorized type, furnished and installed by MC. Fire alarm control and power connections by EC. A subscript is used to identify the device with a specific air handler or zone for its sequence of operation. Refer to the Operation Matrix and these specifications for complete requirements.
- B. **[FA-254]:** Duct Smoke Detector and Smoke Damper Control:
 - 1. Sampling type duct detector [FA-122] in ducts 18" and larger. In-duct smoke detector [FA-123] in ducts less than 18". Detector shall be mounted within 5' of smoke damper. Motorized type smoke damper furnished and installed by MC. Fire alarm control and power connections by EC. Remote indicator [FA-241] or [FA-242] mounted in visible location. Provide auxiliary relay base or addressable control module. The smoke damper shall close upon activation of the detector, and a supervisory signal shall be sent to the fire alarm control panel.
- C. **[FA-260]:** Flow Switch:
 - 1. Connection to flow switch to monitor fire protection flow switch or discharge output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed and MC; wired by EC.
- D. **[FA-261]:** Monitor Switch:
 - 1. Connection to monitor switch to monitor fire protection system supervisory switches or output contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC.
- E. **[FA-262]:** Post Indicator Valve:
 - 1. Connection to post indicator valve for sprinkler system supervisory notification. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired by EC. Provide surge protection device as recommended by the fire alarm system manufacturer on line entering/leaving the facility.
- F. **[FA-263]:** Electronic Bell:
 - 1. Electronic bell for sprinkler alarm, electro-mechanical type, 120 VAC. Furnished and installed by MC. Fire alarm control and power connections by EC.

G. **[FA-271]:** Door Hold Open Device:

1. Integral with door hardware. Furnished and installed by GC. Fire alarm control and power connections by EC.

H. **[FA-272]:** Hold Open Override:

1. Hold open override connection to GC-provided power door operator. EC shall intercept the hold open switch wiring (unless specific contacts for this purpose are provided on the door) and connect addressable relay to override this switch and allow the door to close. All modifications to the power door operator shall be coordinated with the GC.

2.9 WIRING

A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with NFPA 70, Article 760 for power-limited fire alarm signal service.

B. Approved manufacturers of fire alarm cable:

1. Comtran Corp.
2. Helix/HiTemp Cables, Inc.
3. Rockbestos-Suprenant Cable Corp.
4. West Penn Wire/CDT.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

A. General:

1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.
2. All system output programs assigned via control-by-event equations to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

B. Panel/Annunciator Alarm, Trouble, Supervisory Indication:

1. Appropriate system Alarm, Trouble, or Supervisory LED shall flash at the control panel, transponder, and annunciator locations.
2. A local signal in the control panel shall sound.
3. The LCD display shall indicate all information associated with the condition, including the name of the item, type of device and its location within the protected premises.
4. History storage equipment shall log the information associated with the fire alarm control panel (FAP) condition, along with the time and date.
5. Transmit the appropriate signal (supervisory, trouble, alarm) to the central station via the digital communicator.
6. Transmit the appropriate signal (supervisory, trouble, alarm) to the building automation system via addressable relays tied to contact monitors on the system.

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- C. Audible Alarms Sequence:
1. Audible alarms throughout the building shall sound.
- D. Visual Alarms Sequence:
1. Visual alarms throughout the building shall flash.
- E. Fire Protection Electric Sprinkler Bell Sequence:
1. The fire alarm shall utilize an addressable relay to energize the electric sprinkler bell upon activation of the flow switch.
- F. Double Interlocked Preaction Sprinkler Activation Sequence:
1. The fire alarm system shall utilize an addressable relay to signal the double-interlock preaction sprinkler system to allow filling with water upon initiation of alarm in zone of sprinkler coverage.
 2. Where there are multiple zones to the preaction system, a separate addressable relay shall be provided for each zone and the system shall be programmed to signal only the zone that is in the area of the fire. Coordinate with the fire protection system installer.
 3. The fire alarm system shall utilize addressable monitor modules to monitor the control panel supervisory and trouble conditions.
- G. Smoke Damper Control Sequence:
1. The fire alarm system shall utilize an addressable relay to open the power connection to smoke or fire/smoke dampers and allow them to close. Coordinate other requirements with damper installer.
 2. Where a damper is located in a main air duct, where closure of that single damper will entirely block airflow in the duct system, the smoke damper sequence shall also initiate the AHU shutdown sequence for the affected unit.
 3. The AHU shutdown sequence shall be initiated only when ALL of the dampers associated with that unit are closed. Otherwise, the AHU shall continue to serve other areas.
 4. Smoke and fire/smoke dampers located in branch ductwork shall be closed individually or in groups, as identified on the plans.
- H. AHU Shutdown Sequence:
1. The fire alarm system shall utilize addressable relays to de-energize all AHU motor controllers. Coordinate other requirements with HVAC installer.
 2. The fire alarm system shall directly shut down the AHU through the local HVAC control device (i.e., variable frequency drive or motor starter).
 3. Where a facility has more than one AHU, each shall be shutdown individually based on input from initiation devices in the area served by the unit or designated for each AHU.
- I. Fire Door Release Sequence:
1. The fire alarm system shall utilize an addressable relay to signal the fire door or curtain to close. Once the alarm is cleared, the addressable relay shall allow the door to open.

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2. Where a facility has more than one fire door, each shall release individually based on input from initiation devices in the vicinity of each door and noted specifically for door closure.
- J. Door Holder Release Sequence:
1. The fire alarm system shall utilize an addressable relay to open the power connection to integral and magnetic door holders.
 2. The fire alarm system shall utilize an addressable relay to open the 'hold' switch circuitry, integral to the power door.
 3. Door holders shall release individually based on initiation devices in the vicinity of the door and noted specifically for door closure.
- K. Elevator Recall Sequence:
1. Elevator recall sequences shall meet the requirements of ASME/ANSI A17.1 and NFPA 72.
 2. Upon signal from a smoke detector in the machine room, hoistway, or any elevator lobby other than the "designated level" the fire alarm shall utilize an addressable relay to signal the elevator to recall to the designated level as determined by the Authority Having Jurisdiction.
 3. Upon signal from a smoke detector in the elevator lobby of the "designated level," the fire alarm system shall utilize an addressable relay to signal the elevator to recall to the "alternate level" as determined by the Authority Having Jurisdiction.
 4. All elevators, throughout the building, shall be recalled simultaneously.
- L. Firefighter's Cab Visual Alarm Sequence:
1. Upon signal from a detector in the machine room or elevator hoistway, the fire alarm system shall utilize an addressable relay to signal the elevator controller to illuminate and flash the firefighters cab visual alarm.
- M. Elevator Shutdown Sequence:
1. Elevator shutdown shall meet the requirements of ASME/ANSI A17.1.
 2. All elevators that share the same hoistway, machine room, or lobby shall be shut down simultaneously. Elevators served by different machine rooms, hoistways, and lobbies shall continue to operate.
 3. The fire alarm system shall utilize an addressable relay to energize the shunt trip of the main elevator breaker, disconnecting power to the elevator.
 4. The fire alarm system shall utilize an addressable relay to de-energize the relay on the elevator power module, disconnecting power to the elevator.
- N. Elevator Hoistway Damper Sequence:
1. Provide control of each elevator shaft damper in accordance with ASME/ANSI A17.1, as indicated on the Drawings.
 2. The fire alarm system shall utilize an addressable relay to open or close the elevator shaft vent damper from a manually operated switch.
 3. The hoistway vent damper shall open automatically when the hoistway or elevator lobby smoke detectors activate.

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4. When the damper is in the open position, the fire alarm system shall provide status indication (e.g., "Elevator 2-3 damper open") on the fire alarm panels and annunciators. Once the damper is closed, the status indication shall automatically return to the normal state.

O. Sound Masking Paging System Shutdown Sequence:

1. The fire alarm system shall utilize addressable relays or RS-485 interface to disconnect the signal source or de-energize the amplifiers to shut down all sound masking paging systems. Coordinate with masking paging system supplier to provide necessary interface at all sound system equipment locations.
2. The fire alarm interface and associated relays, etc. shall not induce any noise onto the audio system and shall not affect the performance or audio-quality of the system during normal use.

3.2 INSTALLATION

A. Install system in accordance with manufacturer's instructions and referenced codes.

B. Fire Alarm Control Panel:

1. Install the control panel where shown on the drawings.
2. All expansion compartments, if required, shall be located at the control panel.
3. The fire alarm voice prerecorded messages shall be verified by the Contractor, as approved by the Owner, prior to the shop drawing submittal process.

C. Devices:

1. General:

- a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
- b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.
- c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
- d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall notify the Architect/Engineer to coordinate a different acceptable location.

2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.

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3. Analog Smoke and Heat Detectors:
 - a. In elevator shafts and elevator equipment rooms, provide a heat detector for elevator shutdown within 2' of every sprinkler head. Coordinate with fire protection contractor.
 4. Duct-type Analog Smoke Detectors:
 - a. Duct-type analog smoke detectors shall be installed on the duct where shown on the drawings and details. The sampling tubes shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
 - b. All detectors shall be accessible.
 - c. Duct-type detectors shall be installed according to the manufacturer's instructions.
 5. In-Duct Analog Smoke Detectors:
 - a. In-duct analog smoke detectors shall be installed in the duct where shown on the drawings and details. The devices shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
 - b. All detectors shall be accessible.
 6. Manual Pull Stations:
 - a. Stations shall be located where shown and at the height noted on the drawings.
 7. Addressable Relays and Monitor Modules:
 - a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
 - b. All modules shall be mounted in or on a junction box in an accessible location.
 - c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.
 8. Notification Appliance Devices:
 - a. Devices shall be located where shown on the drawings.
 - b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted on the drawings.
- D. Annunciators:
1. Remote Annunciators: The annunciators shall be located where shown on the drawings and approved by the fire marshal.
- E. Wiring:
1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
 2. Wiring shall be installed in red-colored conduit.

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3. All junction boxes shall be painted red with SLC and NAC circuits identified on cover.
 4. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.
 5. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.
 - a. Fire alarm temporal audible notification for all audio appliances.
 - b. Synchronization of all visual devices where two or more devices are visible from the same location.
 - c. Ability to silence audible alarm while maintaining visual device operation.
 6. Notification Appliance Circuits shall not span floors.
 7. Signal line circuits connecting devices shall not span floors.
 8. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.
- F. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.
1. Power branch circuit conductors: In accordance with Section 26 05 53.
 2. Signaling line circuit: Overall red jacket with black and red conductors.
 3. DC power supply circuit: Overall red jacket with violet and brown conductors.
 4. Notification appliance circuit: Overall red jacket with blue and white conductors.
 5. Door release circuit: Gray conductors.
 6. Central station trip circuit: Orange conductors.
 7. Central station fire alarm loop: Black and white conductors.
- G. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the device shall not have visible knockouts.
- H. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.
- 3.3 FIELD QUALITY CONTROL
- A. Field inspection and testing will be performed under provisions of Section 26 05 00.
 - B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation with O & M manuals in accordance with Section 14.6 of the Code.

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- C. Contractor shall test and adjust the fire alarm system as follows:
1. Speaker taps shall be adjusted to the lowest tap setting which achieves a sound level higher than or equal to the greatest of the following:
 - a. 70dBA.
 - b. 15 dBA above ambient levels as indicated in NFPA 72 Table A.18.4.3.
 - c. 15 dBA above measured ambient. 5 dBA above the maximum measured sound level with duration of more than 60 seconds.
 - d. As specified on the drawings.
 2. Sound level measurement procedure shall meet the following requirements:
 - a. All measurements shall use the 'A' weighted, dBA, sound measurement scale.
 - b. All measurements shall be taken after furnishings, wall coverings and floor coverings are in place.
 - c. All measurements shall be taken after fixed equipment (HVAC units, etc.) producing ambient noise is installed and is in operation.
 - d. All sound level measurements shall be taken at a height of 5' above the finished floor level.
 - e. Measurements shall be taken in every unique room. If there are multiple rooms, which have the identical dimensions and function, 10%, or a minimum of 2 rooms shall be tested. The results from the rooms tested shall be averaged and the remaining rooms may be adjusted per the average.
 - f. Measurements shall be taken on a 20' x 20' grid and the results for all points taken shall be averaged. If the room is smaller than 20' x 20' a minimum of two measurements are required.
 - g. Measurements shall be taken halfway between speakers or halfway between a speaker and the wall. No measurements shall be taken at the extreme edges of the room, nor directly under speakers.
- D. Additionally test the voice alarm communication system intelligibility per IEC 60849:
1. The following acoustically distinguishable spaces shall be tested: All unique rooms shall be tested. If there are multiple rooms with the identical dimensions and function, 10%, or a minimum of two (2) rooms, shall be tested. The results from the rooms tested shall be averaged, and the remaining rooms may be adjusted per the average.
 2. Utilize equipment designed to test per IEC 60849 per the equipment manufacturer's instructions. This equipment includes a signal generator, which is input to the fire alarm system and a portable measurement device. This equipment is available from Simplex Grinnell or Gold Line.
 3. Testing equipment that can simulate 'crowd babble' shall be used in rooms with occupancy of greater than 200.
 4. Wide-area notification intelligibility shall be tested in acoustically distinguishable spaces and areas as designated by the Owner.

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5. When testing for intelligibility, the quantity and location of the measurement points shall be the same as the points used for measurement of dBA level.
 6. Provide a room by room report, showing the average dBA level and STI for each room tested, the number and location of. The report shall be presented to the Architect/Engineer in an Excel .xls file.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Provide manufacturer's field services under provisions of Section 26 05 00.
- B. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.
- C. Note that room numbers depicted on the architectural/engineering drawings will not necessarily reflect the actual room (signage) numbers that the Owner selects. The Contractor and fire alarm manufacturer shall coordinate the actual room numbers as the Owner directs to identify each device. This list shall be a part of the floor plan record drawing to be turned in at the project closeout.
- D. System occupancy adjustments: When requested by Owner within 12 months of date of Substantial Completion, provide on-site system adjustments to suit actual occupied conditions. For this purpose, provide up to two (2) site visits, 4 hours each visit, outside normal occupancy hours.

3.5 SYSTEM TRAINING

- A. System training shall be performed under provisions of Section 26 05 00.
- B. Minimum on-site training times shall be:
 1. System Operators: One (1) day.
 2. Emergency Communication System: Four (4) hours.

END OF SECTION 28 31 00

1 SECTION 310510 – SITE PREPARATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Protection of improvements, plants, and utilities.
9 2. Removal and replacement of improvements.
10 3. Location of utilities and coordination with utility companies.
11 4. Clearing and grubbing trees and vegetation.
12 5. Topsoil salvage.
13 6. Site demolition and abandonments.

14 B. Related Requirements:

- 15 1. 015639 Temporary Tree and Plan Protection
16 2. 024100 Demolition
17 3. 310510 Earth Moving

18 PART 2 - (NOT USED)

19 PART 3 - EXECUTION

20 3.1 PROTECTION

- 21 A. Protect improvements on site and on adjoining properties. Provide barricades, coverings, or other types of
22 protection as necessary to prevent damage and to safeguard against injury. Restore to original condition
23 improvements damaged by the work or improvements which required temporary removal during construction.
- 24 B. Protect existing vegetation indicated in accordance with Section 01 56 39.
- 25 C. Maintain survey monuments, reference points, and benchmarks; notify Owner of disturbance to markers.
- 26 D. No extra payment or time will be allowed for protection work that could have been suspected or anticipated by site
27 inspection and interpretation of bidding documents prior to execution of contract.

- 1 3.2 LOCATING EXISTING UTILITIES
- 2 A. Location and description of underground utilities and structures shown on drawings are approximate and are based
3 on records available to Owner or surface features indicating their existence. There may be other utilities within
4 project area that are not shown.
- 5 B. Notify all affected utility companies of construction operations at least three working days before beginning work
6 near their facilities. Do not begin excavation work until underground utility locations have been marked.
- 7 C. Use caution when excavating so that exact location of underground utilities, both known and unknown, may be
8 determined. Provide adequate protection and support for utilities during construction operations.
- 9 D. If uncharted or incorrectly charted utilities are encountered during excavation work, or if proposed construction
10 conflicts with existing utilities, give prompt notice and submit proposed solution to A/E for approval. Cooperate
11 with Owner and public and private utility companies to keep their services and facilities in operation. Repair
12 damaged utilities to satisfaction of utility owner.
- 13 3.3 SITE CLEARING
- 14 A. Remove trees, stumps, snags, shrubs, brush, heavy growths of grass, weeds and other vegetation, improvements,
15 rubbish and debris, and obstructions that interfere with proposed construction; remove items only as necessary for
16 completion of work.
- 17 B. Cut brush and vegetation flush with ground. Grub out stumps, roots having a diameter of 2 in. or larger, and root
18 clusters to a depth of at least 2 ft below subgrade elevation for pavements, structures, and embankments and 6 in.
19 below ground surface in other areas.
- 20 C. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches
21 obstruct new construction. Cut back roots a minimum of 1 ft from concrete work, paving, and structures and to a
22 depth of not less than 2 ft below structures, foundations, and embankments.
- 23 3.4 TOPSOIL STRIPPING
- 24 A. Topsoil shall include all friable, fertile, loam soil suitable for grass and plants, found at surface, reasonably free of
25 subsoil, clay lumps, stones, objects over 2-in. diameter, weeds, large roots, root clusters, and other objectionable
26 material.
- 27 B. Strip topsoil from project area to whatever depths encountered; prevent intermingling with underlying subsoil or
28 other objectionable material. Remove heavy growths of grass from areas before stripping topsoil.
- 29 C. Where trees are indicated to remain, terminate stripping a sufficient distance from such trees to prevent damage to
30 root system.
- 31 D. Stockpile topsoil in storage piles in areas where designated. Construct storage piles to freely drain surface water.
32 Cover or sprinkle water on storage piles to prevent windblown dust.
- 33 3.5 DEMOLITION
- 34 A. Comply with the requirements of Section 024116 Demolition.

- 1 3.6 ABANDONMENTS
- 2 A. Pipes designated to be abandoned in place shall be permanently plugged with concrete a minimum of 24 in. at each
3 open end, including at manholes.
- 4 B. Manholes, tanks, and basins designated to be abandoned shall be perforated for drainage and filled with
5 compacted granular soil (1-1/2-in. maximum size) and walls shall be removed to 2 ft below finished grade.
- 6 3.7 DEBRIS DISPOSAL
- 7 A. Remove debris and excess materials from site and legally dispose of it; do not burn debris.
- 8 END OF SECTION

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1 SECTION 312000 – EARTH MOVING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Earth moving as shown and as specified

- 9 B. Related Requirements:

- 10 1. Section 310510 Site Preparation.

11 1.3 DEFINITIONS

- 12 A. References to "WIDOT Std. Spec." shall mean Wisconsin Department of Transportation, Standard Specifications for
13 highway and Structure Construction, latest edition.

14 1.4 REFERENCES

- 15 A. City of Madison Standard Specifications for Public Works Construction, Current Edition.

16 1.5 CLASSIFICATION

- 17 A. Excavation of materials encountered under this work will be unclassified without regard to type, difficulty to
18 remove, or suitability for use in construction.

19 1.6 SUBMITTALS

- 20 A. Test Reports: Submit reports for laboratory and field tests required under "Testing" article. Test reports for
21 footing, slab, and pavement subgrades shall be submitted prior to placing concrete or paving materials. Make
22 submittals in accordance with contract documents.

23 1.7 TESTING

- 24 A. Contractor shall arrange and pay for soil sampling and testing by a qualified testing agency, acceptable to Owner
25 and independent of Contractor. Test soil materials for suitability for intended purpose.

- 1 B. Test subgrade and fill materials for gradation in accordance with ASTM C136 for conformance with ASTM D2487
2 gradation limits. Test materials for liquid limit and plasticity index in accordance with ASTM D4318. Analyze
3 materials within 3 ft of finished grades of paved areas to determine frost susceptibility.
- 4 C. Provide one optimum moisture-maximum density curve for each type of soil encountered in subgrade and fills
5 under structure slabs and foundations and paved areas; determine maximum densities in accordance with ASTM
6 D1557.
- 7 D. During course of work, testing agency shall inspect and approve subgrades and fill layers before further
8 construction work is performed on each layer. Perform field density tests in accordance with standard, recognized
9 procedures. Take tests as follows:
- 10 1. Footing Subgrade: Perform at least one field density test to verify required design bearing capacities shown
11 on drawings for every 10,000 sq ft of structure area, but in no case less than three tests.
- 12 2. Structure Slabs and Paved Areas: Perform at least one field density test on fill subgrade for every 2000 sq ft
13 of structure slab or paved area, but in no case less than three tests. In each compacted fill layer, perform at
14 least one field density test for every 2000 sq ft of overlying structure slab or paved area, but in no case less
15 than three tests.
- 16 3. Utility Trench Backfill (Pavement and Structure Areas): Perform at least two field density tests in random
17 compacted backfill layers for every 400 linear feet of trench under pavements and structures.
- 18 4. Foundation Wall Backfill: Perform at least two field density tests at locations and elevations as directed.
- 19 E. If in opinion of A/E, based on reports of testing agency and inspection, subgrade or fills which have been placed are
20 below specified density, provide additional compaction and testing at no additional cost to Owner.
- 21 1.8 PROTECTION
- 22 A. Protect existing improvements, utilities, trees and shrubs, and reference marks in accordance with Sections 310510
23 Site Preparation and 315639 Temporary Tree and Plant Protection.
- 24 B. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
- 25 C. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become
26 eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather
27 conditions.
- 28 D. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional
29 soil material, compact, and reconstruct surfacing. Restore appearance, quality, and condition of finished surfacing
30 to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- 31 1.9 BLASTING
- 32 A. Use of explosives is not permitted.
- 33 PART 2 - PRODUCTS
- 34 2.1 SOIL MATERIALS, GENERAL
- 35 A. Soil materials shall be free of organic matter, debris, frozen soils, ice, and other objectionable materials. Rock
36 particles larger than maximum size specified shall be removed prior to placement of soil.
- 37 B. Select existing material from required excavations may be used for fill or backfill if it meets the specified product
38 requirements. If necessary, furnish additional approved material from suitable off-site sources.

- 1 2.2 GRANULAR FILL
- 2 A. Select soils complying with ASTM D2487 soil classification groups GW (well-graded gravel), GP (poorly-graded
3 gravel), SW (well-graded sand), or SP (poorly-graded sand). Aggregate shall pass a 1-1/2-in. sieve and not more
4 than 35% shall be retained on a No. 10 sieve. Maximum 5% by weight shall pass a No. 200 sieve.
- 5 2.3 STRUCTURAL FILL
- 6 A. Select soils complying with ASTM D2487 soil classification groups GW, GP, SW, or SP; or these groups in
7 combination with groups GM, GC, SM, or SC (dual symbol soils). Aggregate shall pass a 1-1/2-in. sieve and not more
8 than 35% shall be retained on a No. 10 sieve. Maximum 12% by weight shall pass a No. 200 sieve; plasticity index
9 shall not exceed 5.
- 10 2.4 GENERAL SITE FILL
- 11 A. Select, natural, free draining soils complying with ASTM D2487 soil classification groups GW, GP, SW, SP, GM, GC,
12 SM, SC, or combinations thereof, and suitable for compaction. Maximum aggregate size shall be 1/2 specified lift
13 thickness.
- 14 2.5 GRANULAR BEDDING AND BACKFILL
- 15 A. Select soils suitable for use as Granular Fill, except coarse aggregate shall pass a 3/4-in. sieve.
- 16 2.6 CLEAR STONE
- 17 A. 5-inch minus select material without fines per WisDOT Standard Specification Section 312 Select Crushed Material.
- 18 PART 3 - EXECUTION
- 19 3.1 PREPARATION
- 20 A. Prepare site for work in accordance with Section 31 05 10.
- 21 B. Layout and stake lines and grades as required to complete the work.
- 22 3.2 EXCAVATION FOR STRUCTURES
- 23 A. Excavate to achieve necessary dimensions, lines, and grades. Conform to elevations and dimensions shown within a
24 tolerance of plus or minus 1 in., and extending a sufficient distance from footings and foundations as required for
25 bracing and supports, concrete formwork, installation of services, other required construction, and for inspection.
- 26 B. For footings and foundations, take care not to disturb bottom of excavation. Excavate to final grade just before
27 concrete is placed. Trim bottoms to required lines and grades to leave solid, undisturbed base to receive granular
28 fill, base course, or concrete as shown.
- 29 3.3 EXCAVATION FOR PAVEMENTS
- 30 A. Cut surface under pavement to comply with cross-sections, elevations, and grades as shown.

- 1 3.4 TRENCHING
- 2 A. Excavate trenches so that pipe can be laid safely and accurately to required line and grade. Hand excavate for bells,
3 fittings and projections to allow for proper jointing and to ensure that pipe rests evenly along barrel and is not
4 resting on bell.
- 5 B. In sand and gravel soils, bottom of trench may be shaped to fit bottom 1/3 of pipe. In silt or clay soils, bottom of
6 trench shall be 4 in. below pipe barrel and 3 in. below bell. In rock, bottom of trench shall be 6 in. below pipe
7 barrel. Under foundations and footings, bottom of trench shall be 8 in. below pipe. Provide Granular Bedding as
8 specified below.
- 9 C. Trench widths in ordinary soil shall be limited at top of pipe to not less than a 6 in. clearance on either side of barrel
10 to allow for installation of bedding material between pipe and trench wall. Maximum trench width at top of pipe
11 shall be outside pipe diameter plus 24 in. (30 in. minimum). Trench above top of pipe may be sloped, stepped or
12 vertical to comply with state and federal regulations regarding trenches.
- 13 D. Minimum trench width in rock shall not be less than that for ordinary soil. Maximum trench width shall be outside
14 pipe diameter plus 18 in. for an unsheathed trench, and outside pipe diameter plus 24 in. for sheathed trench.
- 15 3.5 UNAUTHORIZED EXCAVATION
- 16 A. Unauthorized excavation consists of removal of materials beyond indicated elevations or side dimensions without
17 specific direction of A/E. Unauthorized excavation, as well as remedial work, shall be at Contractor's expense.
18 Notify A/E prior to backfilling if unauthorized excavations are made.
- 19 B. Under footings, foundations, underpinning, equipment bases, and retaining walls, fill unauthorized excavation by
20 extending indicated bottom elevation of footing or base to excavation bottom, without altering required top
21 elevation. Lean concrete or compacted fill may be used to bring elevations to proper position when approved by
22 A/E.
- 23 C. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same
24 classification, unless otherwise directed.
- 25 3.6 STABILITY OF EXCAVATIONS
- 26 A. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Slope sides of
27 excavations to angle of repose of material excavated; otherwise, shore and brace where sloping is not possible
28 either because of space restrictions or stability of material excavated. Take precautions to prevent slides or cave-
29 ins when excavations are made in locations adjacent to backfilled excavations, and when sides of excavations are
30 subjected to vibrations from traffic, machinery, or any other source. Comply with applicable codes and ordinances.
- 31 3.7 SHORING AND BRACING
- 32 A. Carry down shoring and bracing as required as excavation progresses. Maintain shoring and bracing while
33 excavations are open.
- 34 B. Provide and maintain shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good
35 serviceable condition. Use timbers that are sound and free of large or loose knots.
- 36 C. Provide permanent steel sheet piling or pressure treated timber sheet piling wherever subsequent removal of sheet
37 piling might permit lateral movement of soil under adjacent structures. Cut off tops as required and leave
38 permanently in place.

- 1 3.8 DEWATERING
- 2 A. Perform earthwork in a manner to prevent surface water and ground water from flowing into excavations.
3 Promptly remove water from excavations using pumps, sumps, and dewatering system components necessary to
4 convey water away from excavations. If underground springs are encountered, notify A/E before proceeding.
- 5 B. Convey water removed from excavations and rain water to collection or run-off areas. Provide and maintain
6 temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use
7 foundation or utility trench excavations as temporary drainage ditches.
- 8 C. Provide filter material, trash screens, and other devices around pumps and intakes to avoid pumping or discharging
9 sediment from construction site.
- 10 3.9 STOCKPILING
- 11 A. Stockpile excavated materials meeting the requirements for fill and backfill where directed until required for the
12 work. Place, grade, and shape stockpiles for proper drainage. Locate stockpiles a sufficient distance from edge of
13 excavations, even though such excavations may be sheeted and braced, to prevent such material from falling or
14 sliding into excavations and to prevent cave-ins. Cover to prevent windblown dust. Do not stockpile within drip line
15 of remaining trees.
- 16 3.10 COLD WEATHER PROTECTION
- 17 A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg F by covering with
18 dry insulating materials of sufficient depth to prevent frost penetration.
- 19 3.11 SUBGRADE EXAMINATION AND PREPARATION
- 20 A. Examine subgrade prior to placing fill. Remove organic materials and debris subject to rot or corrosion. Plow, strip,
21 or break-up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with subgrade.
- 22 B. In structure, pavement, and walk areas, proof-roll exposed subgrade with a large vibratory roller rated for a
23 minimum compactive force of 20,000 lb to compact subgrade and detect areas which must be undercut or
24 improved. Inform A/E of unsuitable, unconsolidated subgrade soils.
- 25 C. After subgrade soil is stable, scarify top 6 to 8 in., moisture condition, and compact surface to density specified in
26 Part 4 Schedules.
- 27 D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction
28 activities, as directed by A/E, without additional compensation.
- 29 3.12 ADDITIONAL EXCAVATION (OVER EXCAVATION)
- 30 A. If unsuitable bearing materials, such as poorly compacted fill, existing foundations, rubble, debris, or organic
31 deposits, are encountered at required subgrade elevations, carry excavations deeper and replace excavated
32 material with properly compacted Structural Fill as directed by A/E.
- 33 B. Where over excavation below footing subgrade is required, widen over excavation beyond footing edges at least 1
34 ft for each 1 ft of over excavation depth.
- 35 C. Removal of unsuitable material and its replacement as directed will be paid for as extra work, unless a pay item is
36 included in the Bid Schedule. Do not proceed with extra or unit price work until authorized.

- 1 3.13 FILLING AND BACKFILLING, GENERAL
- 2 A. Do not place fill until required subgrade preparation has been examined and approved by testing agency.
- 3 B. Backfill excavations as promptly as work permits, but not until completion of the following:
- 4 1. Acceptance by A/E of construction below finish grade including, where applicable, dampproofing,
5 waterproofing, and perimeter insulation.
- 6 2. Inspection, testing, approval, and recording locations of underground utilities.
- 7 3. Removal of concrete formwork.
- 8 4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet
9 piling driven below bottom of structures and remove in manner to prevent settlement of the structure or
10 utilities, or leave in place if required.
- 11 5. Removal of trash and debris.
- 12 6. Placement of permanent or temporary horizontal bracing on horizontally supported walls.
- 13 C. Place fill or backfill in approximately horizontal layers; do not exceed the maximum lift thickness specified in Part 4
14 Schedules before compaction. Spread piles and windrows uniformly.
- 15 D. Adjacent to structures, place fill or backfill to prevent damage and allow structures to assume loads gradually and
16 uniformly, at approximately the same rate on all sides of structure. Adjacent to earth-retaining structures, do not
17 place fill or backfill until concrete has reached specified 28-day compressive strength (minimum 14 days). Do not
18 travel heavy equipment over cast-in-place concrete work until it has reached specified 28-day compressive strength
19 (minimum 14 days), unless otherwise approved.
- 20 3.14 SOIL FILL
- 21 A. Place and compact fill materials in layers to required elevations as follows:
- 22 1. Under grass and planted areas: Use General Site Fill.
- 23 2. Under footing, foundation, building slab, pavement, and walk areas: Use Structural Fill.
- 24 3. For upper 6 in. immediately under building slabs and walks: Use Granular Fill.
- 25 4. For backfill behind retaining walls: Use Granular Fill unless otherwise shown on the plans.
- 26 B. Do not place soil fill on frozen subgrades.
- 27 3.15 TRENCH BEDDING AND BACKFILL
- 28 A. Trenches dug in sandy or gravelly materials may use undisturbed earth for bedding provided surface is shaped to
29 conform to pipe. Provide Granular Bedding in all other trenches from subgrade to a point supporting bottom 1/3 of
30 pipe for rigid pipe and to springline (mid-height) for flexible pipe. Place and compact bedding so that it fills and
31 supports pipe haunch area.
- 32 B. Immediately after installation of pipe, provide tamped Granular Backfill up to a minimum depth of 1 ft above pipe.
33 Take special care in placing and tamping initial backfill material so alignment and grade of pipe is not disturbed nor
34 pipe damaged.
- 35 C. Backfill more than 1 ft over pipe shall meet material requirements for area in which pipe is located.
- 36 3.16 GRADING
- 37 A. Grade areas within project limits to achieve cross sections, lines, and elevations indicated. Slope grades to direct
38 water away from structures and to prevent ponding. Finish surface to be reasonably smooth and free from
39 irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

1 B. Finish subgrades to required elevations within the following tolerances:

- 2 1. Lawn or Unpaved Areas: Plus or minus 1 in.
- 3 2. Pavements and Walks: Plus or minus 0.5 in.
- 4 3. Structure Slabs: Tolerance of 0.5 in. when tested with 10 ft straightedge.

5 3.17 CONTROL OF MOISTURE CONTENT

6 A. During placement and compaction, maintain moisture content of materials within optimum range.

7 B. Apply water to fill materials by sprinkling materials at borrow site or after placement on fill if necessary. Obtain
8 uniform moisture distribution by discing, blading or other approved methods prior to compaction of layer.

9 C. If material is too wet when deposited on fill, remove or dry it to specified moisture content prior to compaction.

10 D. If top surface of a preceding layer of compacted fill becomes too dry to permit suitable bond, scarify and moisten it
11 by sprinkling to an acceptable moisture content prior to placement of next layer of fill.

12 3.18 COMPACTION

13 A. Compact each layer of soil material to not less than the percentage of maximum density specified in Part 4
14 Schedules.

15 B. Provide compaction equipment required to obtain specified compaction. Compaction by travel of grading
16 equipment is not considered adequate for uniform compaction. Small vibratory compactors are required wherever
17 fill is placed adjacent to foundation walls, footings, and piers. Pipe bedding and initial backfill shall be hand or
18 mechanically tamped.

19 3.19 MAINTENANCE

20 A. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather,
21 scarify surface, re-shape, and compact to required density prior to further construction.

22 B. Where settling is measurable or observable at excavated areas during general project warranty period, remove
23 surface (pavement, lawn or other finish), add fill or backfill material, compact, and replace surface treatment.
24 Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of
25 restoration to greatest extent possible.

26 3.20 DISPOSAL OF EXCESS AND WASTE MATERIALS

27 A. Remove excess excavated material, trash, debris, and other waste materials and legally dispose of them off-site.

1 PART 4 - SCHEDULES

2 4.1 COMPACTION SCHEDULE

3			Lift	
4	<u>Material Type</u>	<u>Usage</u>	<u>Thickness ⁽¹⁾</u>	<u>Compaction ⁽²⁾</u>
5	Granular Fill	Below concrete slabs.	6"	92%
6		Other designated areas.	8"-10"	90%
7	Structural Fill	Under foundations.	6"-8"	95%
8		Below concrete slabs.	8"-10"	92%
9		Below pavements, walks, and	8"-10"	90%
10		other designated areas.		
11	General Site Fill	Below pipe and conduit.	8"	85%
12		Unpaved areas 10 ft. or less	8"	90%
13		outside structure line.		
14	Granular Bedding	Unpaved areas more than	12"	85%
15		10 ft. outside structure line.		
16	Granular Backfill	Below pipe and conduit.	6"	85%
17	Clear Stone	Initial backfill around pipe	6"	85%
18		and conduit.		
19		Per WisDOT Std Spec. Section 312		
20	⁽¹⁾ Place manually compacted materials in maximum 4 in. layers.			
21	⁽²⁾ Percent of maximum density determined in accordance with ASTM D1557 (Modified Proctor test).			

22 END OF SECTION

SECTION 31 23 00 - FOUNDATION EXCAVATING AND BACKFILLING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The General and Supplementary Conditions of the Construction Contract and Division 1 - General Requirements apply to the work specified in this section.
- B. This section shall include, but is not limited to the following foundation, excavating and backfilling within five feet of the building perimeter.
 - 1. Removal of all unacceptable soil.
 - 2. Furnish and install acceptable fill as specified herein and on the drawings.
 - 3. Prepare subgrade for footings and slab on grade.
- C. The following items are not a part of this specification:
 - 1. Utility trenching and related backfilling outside the building footprint.
 - 2. Subgrade for exterior walks and paving.
- D. Structural notes indicated on the drawings regarding foundation excavating and backfilling should be considered part of this specification.

1.2 QUALITY ASSURANCE

- A. Codes and Standards: Comply with the provisions of the following codes, specifications and standards, except where more stringent requirements are shown or specified.
 - 1. AASHTO T99 - Moisture-Density Relations of Soils Using a 5.5 LB Rammer.
 - 2. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 3. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbs/ft³)
 - 4. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - 5. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using the Modified Effort. (56,000 ft-lbs/ft³)
 - 6. ASTM D2167 – Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 7. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - 8. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases and Sub-bases for Highways or Airports.
 - 9. ASTM D4253 - Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.

- 10. ASTM D4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 11. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
 - 12. ASTM D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 - 13. Geotechnical Engineering Report dated April 28, 2016 by CGC, Inc. on file with the Architect.
- B. Comply with all applicable local, state and federal codes.

1.3 SUBMITTALS

- A. Material Test Reports: Provide the Owner and Architect with the on-site material test reports from the Inspection Agency indicating the interpreting test results for compliance with this specification.
- B. LEED Certification: Submit manufacturer’s certification for each engineered fill material including the following:
 - 1. LEED Credit MRC 4.2 – Recycled content including percentage of pre-consumer (post-industrial) and post-consumer recycled content. Also provide manufacturer’s name and product cost.
 - 2. LEED Credit MRC 5.1/5.2 – Location of manufacturing plant, manufacturer’s name, product cost and location of extraction or harvest of raw materials.

1.4 TESTING AND INSPECTION

- A. Inspection and Testing:
 - 1. The Owner shall employ an Inspection Agency to perform the duties and responsibilities specified below.
 - 2. Refer to architectural, civil, mechanical, and electrical specifications for testing and inspection requirements of non-structural components.
 - 3. Duties of the Inspection Agency:
 - a. Perform all testing and inspection required per the Testing and Inspection Schedule indicated below.
 - b. Furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work.
 - c. Submit a final signed report stating whether the work requiring Inspection was, to the best of the Inspection Agency’s knowledge in conformance with the approved plans and specifications.
 - 4. Structural Component Testing and Inspection Schedule for Section 31 23 00 is as follows:

	Continuous	Periodic
Foundation Preparation		
Verify materials below shallow footings are adequate to achieve the design bearing capacity.		X

	Continuous	Periodic
Foundation Preparation		
Verify excavations are extended to proper depth and have reached proper material.		X
Perform classification and testing of compacted fill materials.		X
Verify use of proper materials, densities, and lift thicknesses during placement and compaction of compacted fill.	X	
Prior to placement of compacted fill, observe subgrade and verify that the site has been properly prepared.		X

B. Minimum testing frequency and locations:

1. Laboratory Testing:

- a. Granular fill: One representative gradation test for each type of material.
- b. Cohesive soils: One representative set of Atterberg limits and moisture density test for each type of material used.
- c. Non-cohesive soils: One representative moisture density test for each type of material used.

2. Field Testing:

- a. The Inspector shall determine the location of testing.
- b. Testing of final utility trench backfill shall begin at a depth of 2 feet above the top of the pipe.
- c. In-place field density test and moisture content tests shall be performed as follows:
 - 1) Fills not within the influence of building foundations and slab on grade: Per civil specifications.
 - 2) Fills within the influence of building foundations and slab on grade, the following criteria shall apply: One test for each 8 inch vertical lift of compacted fill placed per 2,500 square feet of fill area (minimum of two tests per lift per structure for areas smaller than 5,000 square feet).
- d. Additional testing may be required by the Inspector if noncompliance or a change in conditions occurs.
- e. If a test fails, the Contractor shall rework the material, recompact and retest as necessary until specific compaction is achieved in all areas of the trench. All costs associated with this work, including retesting, shall be the responsibility of the Contractor.

1.5 PROTECTION

- A. Contractor shall provide for design, permits and installation of all cribbing, bracing, shoring and other methods required to safely retain earth banks and excavations.
- B. Notify the Architect immediately and discontinue work in affected area if adjacent existing footings are encountered during excavation. Underpin other adjacent structures that may be damaged by excavation work, including service utilities and pipe chases.

- C. Notify the Architect of unexpected subsurface conditions and discontinue work in affected areas until notification to resume.
- D. Protect benchmarks, existing structures, fences, sidewalks, paving, curbing, etc., from excavation equipment and vehicular traffic.
- E. Maintain and protect above and below grade utilities that are to remain.
- F. Provide temporary heating or protective insulating materials to protect subgrades and foundations soils against freezing temperatures or frost during cold weather conditions.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Provide borrow soil materials when sufficient acceptable soil materials are not available from excavations.
- B. Acceptable soils shall comply with the following:
 - 1. Meet ASTM D2487 soil classification groups GW, GP, GM, SW, SP, SM or a combination of these group symbols;
 - 2. Be free of rock or gravel larger than 3 inches in any dimension;
 - 3. Be free of debris, waste, frozen materials, vegetation and other deleterious materials;
 - 4. Have a liquid limit less than 45 and a plasticity index less than 20.
 - 5. Be approved by the Inspection Agency.
- C. Unacceptable soils shall be defined as following:
 - 1. ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, PT or a combination of these group symbols.
 - 2. Unacceptable soils also to include acceptable soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Free-Draining Granular Fill: Free-draining granular fill shall comply with the following:
 - 1. Be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone.
 - 2. Be clean and free of fines.
 - 3. Comply with ASTM D2940.
 - 4. Be uniformly graded as follows:

COARSE AGGREGATE GRADATIONS						
SIEVE SIZE - PERCENT PASSING						
Grade No.	1-1/2"	1"	3/4"	1/2"	3/8"	No. 4
CA7	100	95 ± 5	-	45 ± 15	-	5 max

- 5. Be approved by the Inspection Agency.
- E. Engineered Fill and Utility Base Course shall comply with the following:
 - 1. Be a naturally or artificially graded mixture of natural or crushed gravel, crushed stone, natural or crushed sand; be a recycled concrete crushed to meet the gradation requirements of CA6;
 - 2. Comply with ASTM D2940;
 - 3. Be uniformly graded as follows:

COARSE AGGREGATE GRADATIONS						
SIEVE SIZE - PERCENT PASSING						
Grade No.	1-1/2"	1"	1/2"	No. 4	No. 16	No. 200
CA6	100 to 90	95 ± 5	75 ± 15	43 ± 13	25 ± 15	8 ± 4

- 4. Be approved by the Inspection Agency.
- F. Material Applications: Provide and install material meeting with the above requirements as follows:
 - 1. General fill: Acceptable soils.
 - 2. Backfill against basement and retaining walls: Free-draining granular fill.
 - 3. Backfill at over-excavated areas beneath footings: Engineered fill.
 - 4. Sub-grade layer beneath slabs-on-grade: Refer to Drawings.

2.2 LEED CREDIT

- A. LEED Credit MRc 4.2 – All engineered fill shall contain 100% recycled content.
- B. LEED Credit MRc 5.1/5.2 – All fill materials shall be procured from within 500 miles of the project site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Identify and verify required lines, levels, contours and benchmark elevations for the work are as indicated.
- B. Protect plant life, lawns, other features and vegetation to remain as a portion of the final landscaping.
- C. Contractor shall provide for de-watering of excavations from surface water, ground water or seepage.
- D. Identify known underground utility locations with stakes and flags.

3.2 EXCAVATION

- A. All excavations shall be safely and properly backfilled.
- B. All abandoned footings, utilities and other structures that interfere with new construction shall be removed.

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- C. All unacceptable material and organic material shall be removed from below all proposed slabs-on-grade and the exposed natural soil shall be proof rolled and the compaction verified by the soils testing firm prior to placing fill. Proof-roll with a loaded tandem dump truck, loaded ready-mix truck, roller, or equivalent weight vehicle. Materials exhibiting weakness, such as those exhibiting rutting or pumping, shall be removed and replaced with acceptable compacted fill material.
 - D. Do not excavate within the 45-degree bearing splay of any adjacent foundations.
 - E. Remove lumped subsoil, boulders and rock up to 1/3 cubic yard (measured by volume). Provide Owner with unit price per cubic yard for obstructions larger than 1/3 cubic yard.
 - F. Outside 45-degree bearing splay of foundations, correct areas over excavated with aggregate at no additional cost to the Owner.
 - G. Within the 45-degree bearing splay of foundations, correct areas over excavated with 2000 psi concrete fill at no additional cost to the Owner. Notify the Architect prior to performing such work.
 - H. Hand trim final excavation to remove all loose material.
 - I. Contractor shall form all dams and perform other work necessary for keeping the excavation clear of water during the progress of the work and, at his own expense, shall pump or otherwise remove all surface and perched water which accumulates in the excavations. Perched water that cannot be de-watered in 48 hours of continuous pumping at a minimum rate of 60 gpm in dry weather shall be considered ground water.
 - J. If de-watering is required to lower the static level of the ground water, it will be paid for by the Owner on a unit price basis per hour as extra compensation.
 - K. Stockpile excavated material in the area designated and remove excess material not being used, from the site.

3.3 BACKFILLING

- A. Verify foundation perimeter drainage system is complete and has been inspected prior to backfilling against foundation walls.
- B. Support pipe and conduit during placement and compaction of bedding fill.
- C. Systematically backfill to allow necessary time for natural settlement. Do not backfill over porous, wet, spongy or frozen subgrade surfaces.
- D. Backfill areas to contours and elevations with unfrozen materials.
- E. Unless noted otherwise on the Drawings, make grade changes gradual.
- F. Unless noted otherwise on the Drawings, slope grade away from the building a minimum of 2 inches in 10 feet.
- G. Contractor shall procure the approval of the subgrade from the Inspection Agency prior to the start of any filling or bedding operations.
- H. Place a minimum width of 48 inches of free-draining granular fill against all basement and retaining walls for the full height of the wall. The final 24" of back fill against all basement and retaining walls should consist of a clayey fill cap or other semi impermeable material such as asphaltic or concrete pavement. A non-woven geotextile fabric should be used as a separation layer to encapsulate the free-draining granular fill.
- I. Do not begin any backfill operations against any concrete walls until the concrete has achieved its specified strength.

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- J. Do not backfill against below grade walls without necessary bracing to support the walls or until supporting slab or framing is installed and has been anchored to the wall per the Drawings.
 - K. Place and mechanically compact granular fill in continuous layers not to exceed 6 inches compacted depth.
 - L. Employ a placement method that does not disturb or damage adjacent utilities, vapor barriers, foundation perimeter drainage and foundation waterproofing.
 - M. All surplus fill materials are to be removed from the site.
 - N. Fill material stockpiles shall be free of unacceptable soil materials.
 - O. After work is complete, remove all excess stockpile material and repair stockpile area to its original condition.

3.4 COMPACTION

- A. Compact all fill that will support building footings or floor slabs to 95 percent of the maximum dry density in accordance with ASTM D1557. For relative cohesionless fill materials, where the percent passing the #200 sieve is less than 10 and the moisture density curve indicates only slight sensitivity to changing moisture content, compaction requirements should be changed to 75 percent relative density in accordance with ASTM D4253 and ASTM D4254.
- B. Compact all back fill behind below grade walls to 90 percent of the maximum dry density in accordance with ASTM D1557. Compaction of the wall backfill within 3 to 5 of the walls should be performed with lightweight compaction equipment. For relative cohesionless fill materials, where the percent passing the #200 sieve is less than 10 and the moisture density curve indicates only slight sensitivity to changing moisture content, compaction requirements should be changed to 75 percent relative density in accordance with ASTM D4253 and ASTM D4254.
- C. Compact all fills that support paving and landscape per civil specifications.

3.5 FOUNDATIONS

- A. Each footing excavation should be cleared of all obstructions and other organic or deleterious materials.
- B. Localized areas of unstable or unacceptable material may be discovered during the stripping and excavation operation and may require over-excavation and backfilling. The Inspection Agency shall be present during the proof rolling to evaluate any localized areas and make recommendations regarding over-excavation, backfilling and recompaction of these areas. Fill placement and compaction shall be inspected and tested by the Inspection Agency.
- C. Footing elevations shown on the Drawings designate a minimum depth of footing where an appropriate soil bearing pressure is expected. Footings, piers and/or walls shall be lowered or extended as required to reach soil meeting the design bearing pressure. This work shall be performed under per the recommendations of the Inspection Agency.
- D. All footing excavations shall be recompacted by hand-operated, vibratory compaction equipment, except where compaction will degrade integrity of subgrade soils. In these instances, bottom of footing excavations should be hand-trimmed to remove loose material.
- E. All excavation and recompacted surfaces shall be inspected and tested to a depth of 2.0 feet below the excavated elevation by the Inspection Agency. Additional field density tests should be performed for each one foot of fill material placed. Any areas not in compliance with the compaction requirements should be corrected and re-tested prior to placement of fill material.
- F. For foundation areas where over excavation is performed, place and mechanically compact Engineered fill material in continuous layers not to exceed 6 inches compacted depth.

3.6 SLAB-ON-GRADE

- A. All disturbed areas after the clearing and stripping operation should be proof-rolled and recompacted with a heavy vibratory drum roller (approved by the Inspection Agency) in the static mode. The compactor should make a minimum of 10 passes, with a minimum of one foot overlap of each pass. The compactor speed should be less than 0.2 MPH.
- B. The Inspection Agency shall monitor proof-rolling and compaction operations. This area should then be tested for compaction to a depth of 2.0 feet below the compacted surface prior to the placement of any structural fill material.
- C. Refer to Drawings for required sub-grade preparation beneath slabs-on-grade.

3.7 UTILITY TRENCH BACKFILL (AT SLAB ON GRADE LOCATIONS)

- A. Excavate and backfill utility trenches under wall footings as shown on the Drawings
- B. Place utility base course on subgrades free of mud, frost, snow, or ice.
- C. Place and compact utility base course on trench bottoms and where indicated.
- D. Lay underground utilities on 6" sand bedding, which meets the acceptable criteria of Section 2.1.B.
- E. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- F. After connection joints are made, any misalignment can be corrected by tamping the sand around the utilities.
- G. Place and compact initial backfill of acceptable sand to a height of 6 inches over the utility pipe or conduit in 6 inches layer meeting specified compaction requirements.
- H. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit.
- I. Place and compact final backfill using acceptable soil to final subgrade elevation meeting specified compaction requirements.
- J. Backfill voids with acceptable soil while installing and removing shoring and bracing.
- K. Inspection Agency shall monitor and test compacted backfill to verify final compaction meets the specified requirement.

3.8 TOLERANCES

- A. Top surface of backfilling under paved areas: Plus or minus ½ inch from required elevation.
- B. Top surface of general backfilling: Plus or minus 1 inch from required elevation.

END OF SECTION 31 23 00

1 SECTION 312500 – SITE EROSION CONTROL

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

8 1. Provide site storm sewer system as shown and as specified.

- 9 B. Related Requirements:

10 1. Section 310510 Site Preparation

11 2. Section 312000 Earth Moving

12 1.3 REFERENCES

- 13 A. Applicable provisions of Division 1 shall govern all work under this section.

14 B. Wisconsin Department of Natural Resources Storm Water Construction Technical Standards:
15 http://dnr.wi.gov/topic/stormwater/standards/const_standards.html

16 C. Erosion Control Product Acceptability List ("PAL"), current version as published by the WDOT available at the
17 following website: <http://wisconsin.dot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrcs/tools/pal/default.aspx>.

18 D. Method of measurement and basis of payment sections in any referenced erosion control documents shall not
19 apply to this contract.

20 E. City of Madison Standard Specifications for Public Works Construction, Current Edition.

21 1.4 SUBMITTALS

- 22 A. Shop Drawings: Submit shop drawings for silt sock and silt fence.

23 B. Record Drawings: Contractor shall mark-up of the Erosion Control Plan that is included in these documents showing
24 additional or alternate erosion control measures as needed due to the Contractors means and methods throughout
25 all phases of construction. The Contractor may also be required to submit calculations and backup information
26 showing the proposed measures meet applicable regulations.

- 27 C. Make submittals in accordance with the contract documents.

- 1 1.5 EROSION CONTROL PLAN
- 2 A. The A/ E has prepared an erosion control plan included in these documents for the project. The erosion control plan
3 is in accordance with the City of Madison Standard Specification for Public Works Construction, and Chapters NR
4 151, NR 216, and COMM 60, Wis. Adm. Code. The Contractor will provide additional or alternate erosion control
5 measures as needed due to the contractors' means and methods throughout all phases of construction and at the
6 request of state and local inspectors.
- 7 B. Contractor shall comply with all the requirements of the erosion control plan.
- 8 C. Erosion control and storm water management practices shall be installed and maintained in accordance with the
9 WDNR approved Technical Standards (or equivalent).

10 PART 2 - PRODUCTS

11 2.1 GENERAL

12 2.2 Erosion mats, soil stabilizers, and tackifiers shall be listed on the PAL or the Technical Standards.

13 2.3 When the design or contract includes permanent erosion control or stormwater control features, the contractor
14 may employ these items to control erosion and stormwater during construction activities. However, these features
15 shall be fully cleaned and restored to the original design providing full function for the intended permanent use
16 prior to acceptance of the work.

17 2.4 MATERIALS

18 A. Per Article 210 of the City of Madison Standard Specifications.

19 PART 3 - EXECUTION

20 3.1 INSTALLATION

21 A. Install and maintain erosion control measures as required by the erosion control plan throughout phases of the
22 project. Notify Construction Representative of modifications to the erosion control plan as dictated by Contractor's
23 means and methods, construction phasing or by differing site conditions.

24 B. Contractor shall provide all erosion control measures necessary to prevent and manage polluted runoff from the
25 construction site and discharge of sediment onto adjacent property, into storm sewers or waters of the state.

26 C. Remove silt fence, inlet protection and all temporary erosion control items once the site has been stabilized or as
27 approved by the Owner or A/E. Clean up and restore the surface after removal of temporary erosion control items.
28 Dispose of all temporary erosion control items once they have been removed. Removal of temporary erosion control
29 items shall remain the responsibility of the contractor up to one year following completion of the contract.

30 D. Perform all work in accordance with manufacturer's instruction where these specifications do not specify a higher
31 requirement.

- 1 3.2 GRADING AND EARTHWORK
- 2 A. Install temporary or permanent erosion control measures applicable to each phase of grading or land disturbance
3 prior to commencing that phase.
- 4 B. Clear only those areas designated for the placement of improvements or earthwork before placement of the final
5 cover. Perform stripping of vegetation, grading, excavation, or other land disturbing activities in phases minimizing
6 exposure of bare soil. Do not clear the site of topsoil, trees, and other natural ground covers the commencement of
7 construction. Retain natural vegetation and protect until the final ground cover is placed.
- 8 C. Do not stockpile soil within 25 feet of any roadway, parking lot, paved area, or drainage structure or channel.
9 Provide temporary stabilization and erosion control measures on disturbed areas and soil stockpiles which will
10 remain for a period of more than 7 consecutive calendar days.
- 11 D. Provide temporary or permanent stabilization of slopes 4:1 or greater within two weeks of grading activities.
- 12 E. Remove surplus excavation materials from the site immediately after rough grading. The disposal site for the
13 surplus excavation materials shall also be subject to these erosion control requirements.
- 14 3.3 DRAINAGE
- 15 A. Divert roof drainage and runoff from all undisturbed areas upslope of the site around disturbed areas. Minimize
16 runoff on exposed soil. Provide measures to remove sediment, and debris.
- 17 B. Convey clean or treated runoff to the nearest adequate stormwater facility. Do not discharge water in a manner
18 that will cause erosion or sedimentation of the site or receiving stormwater facility.
- 19 C. Protect storm sewer inlets and catch basins with inlet protection devices meeting the requirements of the WDNR
20 Technical Standards and PAL.
- 21 D. Provide ditch checks in swales or ditches to reduce the velocity of water in the channel. Construct in accordance
22 with WDNR technical standards and PAL.
- 23 E. If applicable, dewatering discharge shall be routed to a sedimentation basin or sedimentation vessel to reduce the
24 discharge of sediments to meet the requirements of WDNR 151. Do not discharge water in a manner that will cause
25 erosion or sedimentation of the site or receiving stormwater facility.
- 26 3.4 TRACKING CONTROL
- 27 A. Construct and maintain Tracking Pads in accordance with the Technical Standards. Provide each entrance to the
28 site with a stone tracking pad according to City of Madison specifications or 50 feet in length with a minimum
29 thickness of 12 inches, whichever is greater. The tracking pad shall be the full width of the egress point. Inspect
30 tracking pads on a daily basis and replace aggregate when no longer effective.
- 31 B. If necessary, provide a crushed aggregate paved parking area.
- 32 C. If applicable, wash water shall be discharged to sedimentation basins, sedimentation vessels, or other such control
33 areas. Untreated wash water shall not be routed to storm sewers or waters of the state.
- 34 3.5 MAINTENANCE
- 35 A. Contractor shall inspect all erosion control measures within 24 hours of the end of each rainfall event that exceeds
36 0.25", or daily during periods of prolonged rainfall, or weekly during periods without rainfall. Immediately repair

1 and/or replace any and all damaged, failed, or inadequate erosion control measures. Submit inspections and
2 actions to the City of Watertown web based self-inspection form as required.

3 B. Re-apply soil stabilizers, tackifiers, polymers and anionic polyacrylamides as needed to prevent erosion of exposed
4 soil.

5 C. Maintain records of all inspections and any remedial actions taken on-site.

6 D. Remove any sediment reaching a public or private roadway, parking lot, sidewalk, or other pavement. Do not
7 remove tracked sediments by flushing. Completely remove any accumulations not requiring immediate attention at
8 least once daily at the end of the workday.

9 E. Frequently dispose of all waste and unused construction materials in licensed solid waste or wastewater facilities.
10 Do not bury, dump, or discharge, any garbage, debris, cleaning wastes, toxic materials, or hazardous materials on
11 the site, on the land surface or in detention basins, or otherwise allow materials to be carried off the site by runoff
12 onto adjacent lands or into receiving waters or storm sewer systems.

13 END OF SECTION

1 SECTION 315639 – TEMPORARY TREE AND PLANT PROTECTION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. General protection and pruning of existing trees and plants that are affected by execution of the Work,
9 whether temporary or permanent construction.

10 B. Related Requirements

- 11 1. Section 024100 Demolition
12 2. Section 310510 Site Preparation
13 3. Section 312000 Earth Moving

14 1.3 DEFINITIONS

- 15 A. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be
16 protected during construction, and indicated on Drawings.

- 17 B. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

18 1.4 PROJECT CONDITIONS

19 A. The following practices are prohibited within protection zones:

- 20 1. Storage of construction materials, debris, or excavated material.
21 2. Parking vehicles or equipment.
22 3. Foot traffic.
23 4. Erection of sheds or structures.
24 5. Impoundment of water.
25 6. Excavation or other digging unless otherwise indicated.

- 26 a. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

- 27 B. Do not direct vehicle or equipment exhaust toward protection zones.

- 28 C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

29 PART 2 - PRODUCTS

30 2.1 MATERIALS

- 31 A. Fencing fixed in position and meeting the following requirements. Previously used materials may be used when
32 approved by E/A.

- 33 1. Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-
34 inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60
35 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and

1 ultimate tensile strength of 2680 psi ; secured with plastic bands or galvanized-steel or stainless-steel wire
2 ties; and supported by tubular or T-shape galvanized-steel or wood posts spaced not more than 8 feet
3 apart.

- 4 a. Four-foot height.
- 5 b. High-visibility orange, nonfading.

6 PART 3 - EXECUTION

7 3.1 EXAMINATION

- 8 A. Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that
9 flows of water redirected from construction areas or generated by construction activity do not enter or cross
10 protection zones.

11 3.2 TREE AND PLANT PROTECTION ZONES

- 12 A. Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the
13 site and construction operations begin in a manner that will prevent entrance to protected area. Construct fencing
14 so as not to obstruct safe passage or visibility at vehicle intersections and where fencing is located adjacent to
15 pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

- 16 1. Set or drive posts into ground as shown without concrete footings. Where a post is located on existing
17 paving or concrete to remain, provide appropriate means of post support acceptable to E/A.

- 18 B. Maintain protection zones free of weeds and trash.

- 19 C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by
20 construction operations, in a manner approved by E/A.

- 21 D. Maintain protection-zone fencing in good condition as acceptable to E/A and remove when construction operations
22 are complete and equipment has been removed from the site.

- 23 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through
24 the protection zone.

25 3.3 EXCAVATION

- 26 A. Excavate at edge of protection zones and for areas indicated within protection zones according to requirements in
27 Section 31 20 00 Earth Moving.

- 28 B. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack
29 with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect
30 roots from damage until they are permanently relocated and covered with soil.

31 3.4 ROOT PRUNING

- 32 A. Prune roots that are affected by temporary and permanent construction.

- 33 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not
34 break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
- 35 2. Backfill as soon as possible.

36 3.5 REGRADING

- 37 A. Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone.
38 Maintain existing grades within the protection zone.

- 1 B. Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single
2 uncompacted layer and hand grade to required finish elevations.
- 3 3.6 REPAIR AND REPLACEMENT
- 4 A. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by
5 construction operations, in a manner approved by E/A.
- 6 1. Submit details of proposed root cutting and tree and shrub repairs.
7 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
8 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
9 4. Perform repairs within 24 hours.
10 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by E/A.
- 11 B. Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition or
12 are damaged during construction operations that E/A determines are incapable of restoring to normal growth
13 pattern.
- 14 1. Provide two new tree(s) of 6-inch caliper size for each tree being replaced that measures more than 6
15 inches in caliper size.
- 16 a. Species selected by E/A.
- 17 2. Plant and maintain new trees as specified in Section 32 93 00 Plants.
- 18 3.7 DISPOSAL OF SURPLUS AND WASTE MATERIAL
- 19 A. Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's
20 property.
- 21 END OF SECTION

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1 SECTION 321205 – ASPHALTIC PAVEMENT

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.
- 6 B. The City of Madison Standard Specifications for Public Works Construction, current edition.

7 1.2 SUMMARY

- 8 A. Section Includes:
 - 9 1. Provide asphaltic pavement, including prepared base, as shown and as specified.
- 10 B. Related Requirements:
 - 11 1. Section 310510 Site Preparation.
 - 12 2. Section 312000 Earth Moving.
 - 13 3. Section 321605 Concrete Curbs, Gutters, Walks, and Drives.

14 1.3 DEFINITIONS

- 15 A. References to "WIDOT Std. Spec." shall mean Wisconsin Department of Transportation, Standard Specifications for
16 Highway and Structure Construction, latest edition.

17 1.4 SUBMITTALS

- 18 A. Test Reports: Submit reports for laboratory and field tests required under "Testing" article. Test reports for base
19 course shall be submitted prior to placing asphaltic pavement. Make submittals in accordance with contract
20 documents.
- 21 B. Submit the specifications for each pavement marking material to project architect/engineer (A/E) unless otherwise
22 directed by the A/E. The submittal for each material shall include the following at a minimum:
 - 23 1. Color
 - 24 2. Batch Number
 - 25 3. Date Manufactured (Material more than one year old will not be accepted)
 - 26 4. Manufacturer Name and Address.

27 1.5 TESTING

- 28 A. Base Course: Contractor shall arrange and pay for base course compaction testing by a qualified testing agency,
29 acceptable to Owner and independent of Contractor. Determine laboratory density of base course material.
30 Perform at least one field density test for every 2000 sq ft of paved area, but in no case less than three tests.

- 1 B. Asphalt Mixture Design: Asphaltic pavement job mix formula shall be derived from tests performed by a qualified
2 testing agency paid for by Contractor. Results of previous tests performed on aggregates from same source and
3 using asphaltic material of same brand as used in a previous mix design may be used. If requested, submit job mix
4 formula for review.
- 5 C. Asphalt Mixture Quality Control: Contractor shall maintain a quality control program in accordance with WIDOT
6 Std. Spec., Subsection 460.2.8 to ensure that the asphalt produced meets the job mix design, but documentation
7 submittals are not required. Owner will not provide mix verification testing.

8 PART 2 - PRODUCTS

9 2.1 RECYCLED PRODUCTS AND MATERIALS

- 10 A. The City of Madison strongly encourages the use of recycled materials and products containing recycled materials.
11 Bidders may submit specifications for recycled materials and products containing recycled materials for
12 consideration by the City of Madison Engineering Dept., for use on the project at least ten (10) days prior to the bid
13 date.

14 2.2 BASE COURSE

- 15 A. Crushed stone or crushed gravel meeting requirements of WIDOT Std. Spec., Section 305, for 1-1/4 in. base.

16 2.3 ASPHALTIC PAVEMENT

- 17 A. Hot-mixed asphaltic mixture consisting of 5 to 7 percent asphalt cement (by weight), aggregate, and mineral filler
18 (as required) meeting requirements of WIDOT Std. Spec. Section 450 and Section 460 shown on the plans. Conform
19 all materials provided under this section to the requirements of WIDOT Std. Spec. Section 455 and as revised in any
20 current Supplemental Specifications.

21 2.4 TRAFFIC MARKING PAINT

- 22 A. Acrylic copolymer traffic marking paint complying with WisDOT standard specification Section 646. Use PROMAR
23 Low VOC Acrylic CoPolymer Traffic Marking Paint or Approved Equal. Color shall be yellow.

24 PART 3 - EXECUTION

25 3.1 PREPARATION

- 26 A. Shape and compact subgrade to uniform density and to required alignment and cross-section. Foundation shall be
27 smooth and at proper elevation and contour to receive base course.

- 28 B. Whenever new work adjoins existing pavement, saw cut existing pavement to form a straight, vertical joint line.

29 3.2 PLACING BASE COURSE

- 30 A. Place base course to grade as shown with proper allowance for asphaltic pavement. Place base course in maximum
31 8 in. lifts and compact to 95% maximum density at optimum moisture content in accordance with ASTM D698.

- 1 3.3 PLACING ASPHALT MIXTURE
- 2 A. Construct asphaltic pavement in accordance with WIDOT Std. Spec., Subsection 460.3, except as otherwise
3 designated.
- 4 B. Place asphaltic pavement in one or more layers to thicknesses and grades shown using self-propelled spreading and
5 finishing machines. Maximum compacted thickness of individual layers shall not exceed 4 in. for binder courses and
6 2.5 in. for surface courses. Minimum compacted thickness of individual layers shall not be less than 2-1/4 in. for
7 binder courses and 1-1/2 in. for surface courses.
- 8 C. Compact paving to 93% of the target maximum density in accordance with WIDOT Std. Spec., Subsection 460.3.3
9 and ASP-6.
- 10 D. Tolerance on finished surface shall be 1/4 in. in 10 ft. Paving shall meet manholes, curbs, and other construction at
11 required grade.
- 12 3.4 ROLLING
- 13 A. Begin rolling when mixture will bear roller weight without excessive displacement.
- 14 B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- 15 C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside
16 edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with
17 hot material.
- 18 D. Second Rolling: Following breakdown rolling and as soon as possible while mixture is hot. Continue second rolling
19 until mixture has been thoroughly compacted.
- 20 E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling
21 until all roller marks are eliminated and course has attained maximum density.
- 22 F. Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with
23 fresh, hot asphaltic pavement. Compact by rolling to maximum surface density and smoothness.
- 24 G. Protect work using barricades until pavement has hardened.
- 25 3.5 LANE AND PARKING MARKING
- 26 A. Paint line work on asphaltic paving and concrete curbs as shown.
- 27 B. Clean surface in areas to receive markings. Remove all dust, dirt, oil, grease, loose paint, gravel, debris, or other
28 materials and contaminants that might prevent bonding to the pavement. Paint markings and symbols with traffic
29 marking paint. Apply paint with mechanical equipment to produce uniform straight edges. Apply one coat at
30 manufacturer's recommended rate to achieve a minimum wet film thickness of 15 mils. Ensure that lines have a
31 uniform cross section and color. Provide a sharp cutoff on both sides and ends of the line. Pavement markings shall
32 have the dimensions shown on the drawings. If not otherwise specified, marking lines shall have a minimum width
33 of 4 inches. Diagonal marking lines shall be 36 inches on center unless otherwise specified.
- 34 END OF SECTION

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1 SECTION 321416 – PERMEABLE PRECAST CONCRETE UNIT PAVING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Permeable precast concrete pavers.
9 2. Permeable subbase, base, setting bed, and joint opening aggregates.
10 3. Geotextile drainage fabric.

11 1.3 SUBMITTALS

- 12 A. Product Data: Submit product data for pavers and geotextile drainage fabric.

- 13 B. Samples: Submit samples for pavers for color selection/verification.

- 14 C. Test Reports:

- 15 1. Submit gradation analysis for each type of aggregate specified.
16 2. Submit results for aggregate compaction tests specified in "Testing" article below.

- 17 D. Installer Qualifications: Submit documentation of the installer qualifications specified in "Quality Assurance" article
18 below. For each job reference, provide reference's name, postal address, phone, and email address.

- 19 E. O/M Information: Submit maintenance recommendations for permeable pavers.

- 20 F. Make submittals in accordance with Section 013300.

21 1.4 EXTRA MATERIALS

- 22 A. Furnish 100 sq ft of each type and size of paver to Owner for maintenance and repair. Furnish pavers from the same
23 production run as installed materials.

24 1.5 TESTING

- 25 A. Subbase and Base Aggregates in Vehicular Areas: Contractor shall arrange and pay for subbase and base aggregate
26 compaction testing by a qualified testing agency, acceptable to Owner and independent of Contractor. Determine
27 laboratory density of subbase and base aggregate materials.

- 28 1. For subbase, perform at least one field density test for every 2000 sq ft of pavers in vehicular areas, but in
29 no case less than three tests.

1 2. For base, perform at least one field density test for every 2000 sq ft of pavers in vehicular areas, but in no
2 case less than three tests.

3 1.6 QUALITY ASSURANCE

4 A. Source Limitations:

- 5 1. Obtain each type of permeable paver from one source that has resources to provide materials and products
6 of consistent quality in appearance and physical properties.
7 2. Obtain joint opening aggregate from one source.

8 B. Paving Installer Qualifications: Utilize an installer having successfully completed a minimum of three precast
9 concrete paver installations similar in design, material, and extent indicated to this project.

10 C. Quality Standard: Install pavers in accordance with The Interlocking Concrete Pavement Institute (ICPI)
11 "Construction Tolerances and Recommendations for Interlocking Concrete Pavements".

12 1.7 DELIVERY, STORAGE, AND HANDLING

13 A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and
14 sides of stacks with waterproof sheeting, securely tied.

15 B. Store aggregates where grading and other required characteristics can be maintained and contamination can be
16 avoided.

17 1.8 FIELD CONDITIONS

18 A. Install pavers only on unfrozen subgrade and aggregate materials.

19 PART 2 - PRODUCTS

20 2.1 PERMEABLE PRECAST CONCRETE PAVERS

21 A. Basis-of-Design Product: Subject to compliance with requirements, provide Unilock "Eco-Line", or approved equal.

22 B. General Description: Solid interlocking paving units of shapes that provide openings between units, complying with
23 ASTM C936, resistant to freezing and thawing when tested according to ASTM C67, and made from normal-weight
24 aggregates.

25 C. Specific Requirements:

- 26 1. Thickness: 4 in.
27 2. Face Size and Shape: Random Bundle.
28 3. Finish: IL Campo, Brushed face-mix.
29 4. Color: Granite Blend

30 2.2 AGGREGATE SETTING-BED MATERIALS

31 A. General: Provide washed, clean, aggregates having zero plasticity, and which are free from deleterious or foreign
32 matter and contain no No. 200 sieve size aggregate materials.

1 B. Permeable Subbase Aggregate: Sound crushed stone conforming to ASTM D448, Size No. 5, as presented in Table 1.

2

Table 1: ASTM D448, Size No. 5	
Sieve Size	Percent Passing
1-1/2 in.	100
1 in.	90 to 100
3/4 in.	20 to 55
1/2 in.	0 to 10
3/8 in.	0 to 5

3

4 C. Permeable Base Aggregate: Sound crushed stone conforming to ASTM D448, Size No. 57, as presented in Table 2.

5

Table 2: ASTM D448, Size No. 57	
Sieve Size	Percent Passing
1-1/2 in.	100
1 in.	95 to 100
1/2 in.	25 to 60
No. 4	0 to 10
No. 8	0 to 5

6

7 D. Permeable Setting Bed Aggregate: Sound crushed stone conforming to ASTM D448, Size No. 8, as presented in
8 Table 3.

9

Table 3: ASTM D448, Size No. 8	
Sieve Size	Percent Passing
1/2 in.	100
3/8 in.	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

10

11 E. Geotextile Drainage Fabric: Nonwoven needle-punched geotextile, manufactured for subsurface drainage
12 applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with
13 AASHTO M288 and the following, measured according to test methods referenced:

- 14 1. Survivability: Class 2; AASHTO M288.
15 2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D4751.

- 1 3. Permittivity: 0.5 per second, minimum; ASTM D4491.
- 2 4. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

3 2.3 JOINT OPENING MATERIALS

- 4 A. Permeable Joint Opening Aggregate: 1/4 in. minus granite chips. Color to match pavers.

5 Permeable Joint Opening Aggregate: Sound crushed stone conforming to ASTM D448, Size No. 8, as presented in
6 Table 4.

7

Table 4: ASTM D448, Size No. 8	
Sieve Size	Percent Passing
1/2 in.	100
3/8 in.	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

8

9 PART 3 - EXECUTION

10 3.1 PREPARATION

- 11 A. Examine substrates on which pavers will be laid and conditions under which work will be performed; notify of
12 unsatisfactory conditions. Do not proceed until unsatisfactory conditions have been corrected.

13 3.2 INSTALLATION, GENERAL

- 14 A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be structurally
15 unsound or visible in finished work.
- 16 B. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to
17 provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer
18 cutting is not acceptable.
- 19 C. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

20 3.3 SETTING-BED INSTALLATION

- 21 A. Compact soil subgrade uniformly to at least 95 percent of Standard Proctor density (ASTM D698).
- 22 B. Place geotextile drainage fabric over prepared subgrade, overlapping ends and edges at least 12 in.
- 23 C. Place permeable subbase and base, compact to 95% of Standard Proctor density (ASTM D698), and screed to depth
24 indicated.

1 D. Place setting bed aggregate and screed to a nominal thickness of 1-1/2 in., taking care that moisture content
2 remains constant and density is loose and constant until pavers are set and compacted.

3 3.4 PAVER INSTALLATION

4 A. Set pavers on bedding aggregate, being careful not to disturb aggregate. If pavers have lugs or spacer bars to
5 control spacing, place pavers hand tight against lugs or spacer bars. If pavers do not have lugs or spacer bars, place
6 pavers with a 1/16-in. minimum and 1/8-in. maximum joint width. Use string lines to keep straight lines. Fill gaps
7 between units that exceed 3/8 in. with pieces cut to fit from full-size pavers.

8 B. Compact pavers into bedding aggregate with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf
9 compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to
10 prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

- 11 1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36
12 in. of uncompacted pavers adjacent to temporary edges.
13 2. Before ending each day's work, compact installed concrete pavers except for 36-in. width of uncompacted
14 pavers adjacent to temporary edges (laying faces).
15 3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent
16 edges unless they are within 36 in. of laying face.
17 4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted
18 and bedding aggregate on which pavers have not been placed with nonstaining plastic sheets to protect
19 them from rain.

20 C. Place joint opening aggregate immediately after vibrating pavers into bedding aggregate. Vibrate pavers and joint
21 bedding aggregate until joints are completely filled, then remove excess material.

- 22 1. Before ending each day's work, place aggregate fill in installed permeable paving except for 42-in. width of
23 unfilled paving adjacent to temporary edges (laying faces).
24 2. As work progresses to perimeter of installation, place aggregate fill in installed paving that is adjacent to
25 permanent edges unless it is within 42 in. of laying face.
26 3. Before ending each day's work and when rain interrupts work, cover paving that has not been filled with
27 nonstaining plastic sheets to protect it from rain.

28 3.5 CONSTRUCTION TOLERANCES

29 A. Variation from Level or Indicated Slope: No greater than plus or minus 3/8 in. under a 10 ft straightedge for
30 finished surface of paving.

31 B. Lippage at Adjacent Surfaces: No greater than 1/32 in. difference in height between pavers and adjacent paved
32 surfaces.

33 C. Lippage Between Pavers: No greater than 1/8 in.

34 D. Paver Joint Width: No greater than 3/16 in. apart from paver or paver tab.

35 3.6 REPAIRING AND CLEANING

36 A. Repairing: Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that
37 do not match adjoining units. Provide new units to match adjoining units and install in same manner as original
38 units, with same joint treatment and with no evidence of replacement.

39 B. Cleaning: Remove excess dirt, debris, stains, grit, etc. from exposed paver surfaces; wash and scrub clean. Clean
40 pavers in accordance with the manufacturer's written recommendations.

- 1 3.7 PROTECTION
- 2 A. Protect completed work from damage due to subsequent construction activity on the site.
- 3 3.8 PERMEABLE JOINT AGGREGATE MATERIAL REFILLING
- 4 A. Remove all debris from joint and provide additional permeable joint opening aggregate material after 120 days and
- 5 before 150 days after date of Substantial Completion. Fill joint full to lip of paver.
- 6 END OF SECTION

1 SECTION 321610 – SITE CAST-IN-PLACE CONCRETE

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. Provide cast-in-place concrete work as shown and as specified.

9 B. Related Requirements:

- 10 1. Section 044300 Stone Masonry
11 2. Section 107500 Flagpoles
12 3. Section 321205 Asphaltic Pavement
13 4. Section 321605 Concrete Curbs, Gutters, Walks, and Drives

14 1.3 SUBMITTALS

- 15 A. Shop Drawings: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply
16 with ACI 315. Show bar schedules, stirrup spacing, diagrams of bent bars, and arrangements and assemblies of
17 concrete reinforcement. Include special reinforcement required at openings through concrete structures.

- 18 B. Product Data: Submit product data for each product specified.

- 19 C. Mix Designs: Submit proposed mix designs to A/E ten days prior to beginning concrete work. Do not begin
20 concrete production until mixes have been reviewed.

- 21 D. Delivery Tickets: Ready-mixed concrete producer shall furnish duplicate delivery tickets. Contractor shall retain
22 one ticket and attach other to laboratory test report. Delivery tickets shall indicate delivery date, type of concrete,
23 class, cement content, admixtures, and amount of water.

- 24 E. Test Reports: Testing agency shall submit copy of field and laboratory reports to Contractor and A/E.

- 25 F. Make submittals in accordance with contract documents.

26 1.4 QUALITY ASSURANCE

- 27 A. Give A/E two working days' notification of all planned concrete pours so that appropriate construction observation
28 can be present at the project site.

- 29 B. Prior to placing concrete, request review of reinforcement steel by A/E.

1 1.5 CODES AND STANDARDS

2 A. Comply with the following codes and standards, except as otherwise designated:

- 3 1. ACI 301 Specifications for Structural Concrete.
- 4 2. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- 5 3. ACI 315 Details and Detailing of Concrete Reinforcement.
- 6 4. ACI 347 Guide to Formwork for Concrete.
- 7 5. ACI SP-2 Manual of Concrete Inspection.
- 8 6. AWS D1.4 Structural Welding Code-Reinforcing Steel.
- 9 7. CRSI Manual of Standard Practice.

10 1.6 TESTING

11 A. Contractor shall arrange and pay for services of a qualified testing agency acceptable to Owner and independent of
12 Contractor.

13 B. Testing agency shall test concrete to measure slump, entrained-air content, temperature, and compressive strength
14 to determine compliance with specifications. Furnish test apparatus and cylinders, perform on-site sampling and
15 testing, submit samples, and perform laboratory tests. Comply with applicable provisions of ACI SP-2, Manual of
16 Concrete Inspection.

17 C. On-site tests shall be performed under observation of A/E unless waived.

18 D. Slump, Air Content, and Temperature Tests:

- 19 1. Perform slump, air content, and temperature tests prior to concrete placement each day, whenever there is
20 a change in consistency of concrete, and when concrete cylinders are prepared.
- 21 2. Test for slump in accordance with ASTM C143, air content in accordance with ASTM C231, and temperature
22 in accordance with ASTM C1064.
- 23 3. If measured slump, air content, or temperature falls outside specified limits, immediately check another
24 portion of same batch. In event of a second failure, concrete shall be rejected.

25 E. Compressive Strength Tests:

- 26 1. During progress of work, prepare three test cylinders per 100 cu yd or fraction thereof for each class of
27 concrete placed each day.
- 28 2. Comply with ACI 318, Section 5.6 (samples secured, ASTM C172; cylinders prepared and cured, ASTM C31;
29 and tested, ASTM C39) except as otherwise directed.
- 30 3. Identify samples, moist cure in accordance with ASTM C31, and ship samples to testing laboratory for one
31 7-day compressive strength test and two 28-day tests.
- 32 4. Average of any three consecutive strength tests for each class of concrete shall be equal to or greater than
33 specified strength and no individual test shall fall more than 500 psi below specified strength. When test
34 results indicate deficiencies, A/E may require additional tests in accordance with ACI 318, Section 5.6, and
35 may order remedial work. Specimens of cured concrete shall be tested in accordance with ASTM C42.

36 1.7 DELIVERY, STORAGE, AND HANDLING

37 A. Deliver reinforcement bundled and marked using metal tags corresponding to placement diagrams. Store concrete
38 reinforcement to prevent damage and accumulation of dirt or excessive rust.

1 PART 2 - PRODUCTS

2 2.1 CEMENTITIOUS MATERIAL

3 A. Cement: Portland cement, ASTM C150, Type I.

4 B. Fly Ash: ASTM C618, Class C.

5 2.2 AGGREGATES

6 A. Conform to ASTM C33. Local aggregates not complying with ASTM C33 but which have shown by test and actual
7 service to produce concrete of adequate strength and durability may be submitted for approval. Do not use
8 aggregates containing soluble salts or other substances which can cause stains on exposed concrete surfaces.

9 B. Fine Aggregate: Clean, sharp, natural sand, free of loam, clay, lumps and foreign material.

10 C. Coarse Aggregate: Clean, uncoated, processed aggregate free from clay, mud, loam, and other foreign matter.
11 Aggregate may be crushed natural rock, crushed stone, or washed natural or crushed gravel. Use of pit or bank run
12 gravel is not permitted.

13 2.3 WATER

14 A. Clean, potable, and free from oil, acid, alkalines, and organics.

15 2.4 ADMIXTURES

16 A. Air-entraining admixture shall conform to ASTM C260 and be compatible with water reducing and any other
17 admixture.

18 B. Water reducing admixture shall conform to ASTM C494, Class A.

19 C. Accelerating admixture shall conform to ASTM C494, Type C, and shall be free of calcium chloride.

20 2.5 FORMWORK

21 A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct forms for exposed concrete surfaces with
22 water-resistant plywood, metal, metal-framed plywood-faced, or other acceptable panel type materials, to provide
23 continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints
24 and to conform to joint system if shown. Provide form material with sufficient thickness to withstand pressure of
25 newly placed concrete without bow or deflection. Rust-stained steel forms are not acceptable.

26 B. Forms for Unexposed Finish Concrete: Construct forms for concrete surfaces which will be unexposed in finished
27 structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least one
28 side and two edges for tight fit.

29 C. Forms for Cylindrical Columns, Supports, and Flagpoles: Metal, fiberglass reinforced plastic, or paper or fiber tubes.
30 Construct paper or fiber tubes of laminated plies using water-resistant adhesive with wax-impregnated exterior for
31 weather and moisture protection. Provide units with sufficient wall thickness to resist loads imposed by wet
32 concrete without deformation. Sonoco Products "Sonotube", or equal.

- 1 D. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties with a minimum working
2 strength of 3000 lb, designed to prevent form deflection and to prevent spalling concrete upon removal. Unless
3 otherwise indicated, provide ties which will leave no metal closer than 1-1/2 in. to concrete surface and which,
4 when removed, will leave holes not larger than 1 in. diameter in concrete surface. Form ties fabricated on project
5 site and wire ties are not acceptable.
- 6 E. Chamfer Strips: 3/4 in. x 3/4 in. x 45 deg wood, plastic, or rubber.
- 7 F. Form Coating Compound: Commercial form-coating compound that will not bond with, stain, or adversely affect
8 concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor
9 impede wetting of surfaces to be cured with water or curing compounds. Form oil for steel forms shall be non-
10 staining, rust-preventative type.
- 11 2.6 REINFORCING BARS
- 12 A. ASTM A615, Grade 60, deformed, new billet steel.
- 13 2.7 EXPANSION JOINT FILLER
- 14 A. Exterior Joints: Premolded joint filler, ASTM D1751, asphalt-saturated cellulosic fiber; 1/2 in. thickness by depth of
15 concrete, unless otherwise shown.
- 16 2.8 MOISTURE-RETAINING COVER
- 17 A. Waterproof paper, polyethylene film, or polyethylene-coated burlap complying with ASTM C171.
- 18 2.9 CURING COMPOUND
- 19 A. White, waterborne, membrane-forming curing compound, ASTM C309, Type 2, Class B, dissipating.
- 20 2.10 REINFORCEMENT FABRICATION
- 21 A. Shop-fabricate reinforcing bars to conform to required shapes and dimensions; comply with fabrication tolerances
22 of ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or
23 weaken material. Reinforcement with the following defects will not be permitted:
- 24 1. Bar exceeding specified fabrication tolerances.
25 2. Bend or kinks not indicated on Drawings or final shop drawings.
26 3. Bars with reduced cross-section due to excessive rusting or other cause.
- 27 2.11 CONCRETE MIXTURES
- 28 A. Conform to minimum standards for class and usage in Part 4 Schedules.
- 29 B. Prepare design mixes for each type of concrete on the basis of compressive strength by methods recommended in
30 ACI 318. Use an independent materials laboratory for preparing and reporting proposed mix designs.
- 31 C. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on
32 project for each class of concrete required. When laboratory trial batches are used to select concrete proportions,

1 prepare test specimens in accordance with ASTM C192 and conduct strength tests in accordance with ASTM C39 as
2 specified in ACI 301.

3 D. Provide water-reducing admixture for all concrete work. Provide air entraining admixture as scheduled. At
4 Contractor's option, accelerating admixture may be used to reduce exposure of fresh concrete to adverse weather.
5 Calcium chloride as an admixture or contained in an admixture is prohibited. No other admixtures will be
6 permitted, unless approved in writing by A/E. Use admixtures in compliance with manufacturer's printed
7 directions.

8 PART 3 - EXECUTION

9 3.1 FORMWORK INSTALLATION

10 A. Form Design: Design, erect, support, and maintain forms to safely support vertical and lateral loads, until such
11 loads are supported by concrete structure. Carry vertical and lateral loads to ground by form system and in-place
12 construction that has attained adequate strength.

13 B. Form Construction: Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate
14 alignment, location, grades, levelness, and plumbness in finished structures. Provide for openings, offsets, sinkages,
15 keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts,
16 and other accommodations for required features. Solidly butt joints and provide back-up at joints to prevent
17 leakage of cement paste. Use selected materials to obtain required finishes.

18 C. Joints:

- 19 1. Locate joints as shown and in accordance with the following requirements.
- 20 2. Arrange construction joint bulkheads to allow concrete to be placed between construction joints in one
21 continuous operation. Place bulkheads where shown or where approved by A/E. Erect temporary
22 bulkheads at right angles to main reinforcement with tongue and grooved joint 2 in. deep and 1/3 of width
23 of concrete member. Obtain approval from A/E if it becomes necessary to eliminate or relocate
24 construction joints to facilitate use of ganged forms.
- 25 3. Tops of edge forms, bulkheads and screeds shall be set to finished elevations and to provide uniform pitch
26 to drains as shown. If wet screeds are to be used, establish grade stakes or other fixed markers.
- 27 4. Provide snap ties or 5/8 in. bolt inserts greased for easy removal 3 in. to 4 in. below horizontal construction
28 joints at same spacing as regular ties to tighten forms against hardened concrete. Other methods of
29 achieving a leakproof joint may be used with approval of A/E.
30

31 D. Form Coatings: Coat form surfaces with form-coating compound before reinforcement is placed. Do not allow
32 excess form coating material to accumulate in forms or contact existing concrete against which new concrete will
33 be placed. Apply in accordance with manufacturer's instructions.

34 E. Corner Treatment: Form 3/4 in. chamfers at corners to produce uniformly straight lines and tight edge joints.
35 Extend terminal edges to required limit and miter chamfer strips at changes in direction. Unexposed corners may
36 be formed either square or chamfered.

37 F. Provision for Other Trades: Provide openings in concrete forms to accommodate work of other trades, including
38 those under separate prime contracts (if any). Determine size and location of openings, recesses, and chases from
39 trade providing such items. Accurately place and securely support items to be built into forms.

40 G. Cleanouts, Cleaning, and Tightening: Provide temporary openings in forms to facilitate cleaning and inspection.
41 Thoroughly clean forms and adjacent surfaces to receive concrete; remove sawdust, dirt, and debris just before
42 concrete is placed. Retighten forms immediately after concrete placement to eliminate mortar leaks and maintain
43 proper alignment.

1 3.2 EMBEDDED ITEM INSTALLATION

- 2 A. Install sleeves, anchors, and embedded accessories specified in this section and furnished by other trades. Use
3 setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- 4 B. Concrete shall not be placed around castings, frames, joints, and other embedded items until they have been
5 accurately adjusted and set to required alignment and grade. Prior to placing of concrete, castings, frames, and
6 embedded metal fixtures shall be painted on their contact surface with a heavy coat of asphaltic mastic or
7 separated with expansion joint filler.

8 3.3 PLACING REINFORCING BARS

- 9 A. Comply with specified codes and standards, and CRSI recommendations.
- 10 B. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which interfere with bond
11 to concrete.
- 12 C. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete
13 placement operations. Locate and support reinforcing with metal chairs, runners, bolsters, spacers, and hangers, as
14 required to carry reinforcement.
- 15 D. Provide a minimum center-to-center spacing of 2-1/2 bar diameters and a minimum clear spacing between bars 1-
16 1/2 times maximum aggregate size. Place reinforcement to obtain minimum concrete coverages specified below.
- 17 E. Securely tie bars and bar supports together with 16 ga annealed iron wire to hold reinforcement accurately in
18 position during concrete placement operations. Set wire ties so that ends are directed away from exposed concrete
19 surfaces. Do not place reinforcing bars more than 2 in. beyond last leg of any continuous bar support. Do not use
20 supports as bases for runways for concrete conveying equipment and similar construction loads.
- 21 F. Splices and Terminations:
- 22 1. Comply with requirements of ACI 318, CRSI, and as shown.
- 23 2. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying.
- 24 3. Splices and laps indicated in reinforcement for beams, columns, elevated slabs, and walls shall be 30 bar
25 diameters minimum, unless otherwise noted. Stagger adjacent laps and splices, unless otherwise shown.
- 26 4. Horizontal reinforcement in footings, foundations and walls at corners and intersections shall be made
27 continuous using corner bars or "L" dowels of same diameter; lap 30 bar diameters, unless otherwise
28 shown.
- 29 5. Splices not shown on Drawings or shop drawings shall be determined on basis of safe bond stress and stress
30 in reinforcement; splices shall not be less than 24 bar diameters and minimum 12 in. length.
- 31 6. Terminate horizontal reinforcement in beams, elevated slabs and walls with a standard hook, unless
32 otherwise shown.
- 33 G. Where shown, drill and grout reinforcement bars into existing concrete. Use pre-mixed non-shrink grout mixed as
34 dry as practicable. Fill hole with grout and ram reinforcement bar into place. Remove excess grout from surface
35 area.

36 3.4 CONCRETE COVER

- 37 A. Provide the following minimum concrete cover over steel reinforcement, unless otherwise shown:
- 38 1. Footings: 3"
39 Walls exposed to earth: 2"
40 Slabs-on-grade, bottom: 3"

- 1 3.5 CONSTRUCTION JOINTS
- 2 A. Locate and install construction joints as shown or as approved by A/E:
- 3 B. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction
4 joints, unless otherwise indicated. Do not impair strength and appearance of structures.
- 5 3.6 ISOLATION AND EXPANSION JOINTS
- 6 A. Provide expansion joint filler to isolate exterior slabs-on-grade from walls and other vertical building surfaces, and
7 where shown.
- 8 3.7 CONTRACTION JOINTS
- 9 A. Provide contraction (control) joints in slabs-on-grade to form panels of patterns as shown. If joint pattern is not
10 shown, provide joints not exceeding 15 ft in either direction and located to conform to bay spacing wherever
11 possible (at column centerlines, half bays, third-bays).
- 12 3.8 MIXING AND DELIVERY
- 13 A. Concrete shall be ready-mixed and delivered in accordance with ASTM C94 and ASTM C1116. Place concrete within
14 one hour after water is added to batch. Furnish batch certificates for each batch discharged and used in the Work.
- 15 B. No water shall be added on job unless authorized by A/E. If added, record amount of water on all copies of delivery
16 tickets. If water is added to mixed concrete at job, provide twenty revolutions of additional mixing.
- 17 C. Concrete shall arrive at site of work having a temperature not less than 60 deg F (50 deg F for heavy sections) nor
18 greater than 90 deg F.
- 19 3.9 CONCRETE CONVEYING
- 20 A. Handle concrete from point of delivery to locations of final deposit as rapidly as practicable by methods which will
21 prevent segregation and loss of concrete mix materials.
- 22 B. Provide equipment for moving concrete to ensure a continuous flow of concrete. Provide runways for wheeled
23 conveying equipment. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete,
24 debris, water, snow, ice, and other deleterious materials.
- 25 3.10 CONCRETE PLACEMENT, GENERAL
- 26 A. Thoroughly wet wood forms immediately before placing concrete, as required, where form coatings are not used.
27 Dampen subgrade prior to placing concrete on grade without vapor barrier. Remove standing water and mud.
- 28 B. Place concrete as specified and in accordance with ACI 304. Maintain reinforcing steel in proper position, securely
29 anchored.
- 30 C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has
31 hardened sufficiently to cause formation of seams or planes of weakness. If a section cannot be placed
32 continuously, provide construction joints. Deposit concrete as near as practicable to final location to avoid
33 segregation from rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

- 1 D. Screed concrete to proper level to avoid excessive skimming or grouting.
- 2 E. Do not use concrete which becomes non-plastic and unworkable, or does not meet required quality control limits,
3 or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete
4 from project site.
- 5 3.11 PLACING CONCRETE INTO FORMS
- 6 A. Deposit concrete in forms in horizontal layers not deeper than 18 in. and in a manner to avoid inclined construction
7 joints.
- 8 B. Remove temporary spreaders in forms when concrete placing reaches elevation of spreaders.
- 9 C. Consolidate concrete in forms by mechanical vibrating equipment and supplement by hand-spading, rodding or
10 tamping. Use vibrators designed to operate at a speed of not less than 6000 impulses per minute when submerged
11 in concrete. Vibration of forms and reinforcing will not be permitted.
- 12 D. Do not use vibrators to move concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced
13 locations not farther than visibly effective. Do not insert vibrators into lower layers of concrete that have begun to
14 set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete
15 embedment of reinforcement and other items without segregation of mix.
- 16 3.12 PLACING CONCRETE SLABS
- 17 A. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until panel or
18 section is complete.
- 19 B. Consolidate concrete during placing operations using mechanical vibrating equipment. Thoroughly work concrete
20 around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and
21 girders of supported slabs, and against bulkheads of slabs-on-grade, as specified for formed concrete structures.
22 Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other acceptable
23 methods. Limit time of vibrating consolidation to prevent bringing an excess of fine aggregate to surface. Do not
24 push or drag concrete into place.
- 25 C. Bring slab surfaces to correct level with straight edge and strike off. Use bull floats or darbies to smooth surface,
26 leaving it free of humps or hollows. Do not sprinkle water on concrete surface while in plastic state. Do not disturb
27 slab surfaces prior to beginning finishing operations.
- 28 3.13 COLD WEATHER PLACING
- 29 A. Protect concrete work from physical damage or reduced strength caused by frost, freezing actions, or low
30 temperatures, in compliance with ACI 306.
- 31 B. When air temperature falls to or is expected to fall below 40 deg F, uniformly heat water and aggregates before
32 mixing to obtain a concrete mixture temperature of not less than 60 deg F (50 deg F for heavy sections) and not
33 more than 90 deg F at point of delivery.
- 34 C. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on
35 subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are
36 entirely free of frost, snow and ice before placing concrete.

- 1 3.14 HOT WEATHER PLACING
- 2 A. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in
3 compliance with ACI 305 and as specified below.
- 4 B. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Mixing
5 water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is
6 calculated in total amount of mixing water.
- 7 C. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed
8 the ambient air temperature immediately before embedment in concrete.
- 9 D. Spray forms, reinforcing steel, and subgrade just before concrete is placed.
- 10 E. Do not use set-control admixtures, unless approved by A/E.

11 3.15 FINISHING FORMED CONCRETE

- 12 A. Standard Rough Form Finish: Standard rough form finish shall be the concrete surface having texture imparted by
13 form facing material, with defective areas repaired and patched and fins and other projections exceeding 1/4 in. in
14 height rubbed down with wood blocks.
- 15 1. Provide standard rough finish to formed surfaces to be concealed in finish work or by other construction,
16 unless otherwise designated.
- 17 B. Standard Smooth Form Finish: Standard smooth finish shall be the as-cast concrete surface obtained with form
18 facing material, with defective areas repaired and patched and fins and other projections on surface completely
19 removed and smoothed.
- 20 1. Provide standard smooth finish for formed surfaces exposed-to-view or to receive a covering applied
21 directly or bonded to concrete, such as waterproofing, dampproofing, or paint.
- 22 C. Related Unformed Surfaces: At top of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to
23 formed surfaces, strike off and finish with texture matching adjacent formed surfaces. Continue final surface
24 treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

25 3.16 FINISHING UNFORMED SURFACES

- 26 A. Scratch Finish: After placing slabs, plane surface to a tolerance not exceeding 1/4 in. in 2 ft when tested with a 2 ft
27 straightedge. Slope surfaces uniformly to drain where required. After leveling, roughen surface before final set
28 with stiff brushes, brooms, or rakes.
- 29 1. Apply scratch finish to monolithic slab surfaces to receive concrete floor topping, mortar setting beds,
30 portland cement terrazzo, and other bonded finish flooring material, and as shown.
- 31 B. Float Finish: Do not work surface until ready for floating. Begin floating when surface water has disappeared and
32 concrete has stiffened sufficiently to permit operation of power-driven float. Consolidate surface with power-
33 driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to a
34 tolerance not exceeding 1/4 in. in 10 ft when tested with a 10 ft straightedge placed on surface at not less than two
35 different angles. Cut high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling,
36 refloat surface to a uniform, smooth, granular texture. Tool joints as indicated.
- 37 1. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as specified, and slab
38 surfaces to be covered with membrane or elastic waterproofing, roofing, and as shown.

1 C. Non-Slip Broom Finish: Immediately after trowel finishing, slightly roughen concrete surface by brooming
2 perpendicular to main traffic direction.

3 1. Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as designated.

4 3.17 EQUIPMENT PADS

5 A. Unless specifically noted otherwise, furnish and install concrete pads for equipment as shown, using concrete of
6 same type as specified for floor slabs. Provide smooth trowel finish. Install bolts and anchors in concrete as
7 directed by contractor requiring pad.

8 3.18 CONCRETE CURING AND PROTECTION

9 A. General: Protect freshly placed concrete from premature drying, excessive cold or hot temperatures, and
10 mechanical injury. Maintain concrete with minimal moisture loss at a relatively constant temperature for period
11 necessary for hydration and proper hardening.

12 1. Start initial curing as soon as free water has disappeared from concrete surface. Keep continuously moist
13 for not less than 72 hours. Cure and protect concrete at temperatures above 50 deg F for seven days or
14 until 75 percent of the required 28-day compressive strength is obtained, whichever is less. Avoid rapid
15 drying at end of final curing period.

16 2. When atmospheric temperature is 40 deg F and below, maintain concrete temperature at not less than 50
17 deg F continuously throughout curing period. When necessary, make arrangements before concrete
18 placement for heating, covering, insulation or housing as required to maintain specified temperature and
19 moisture conditions continuously for the concrete curing period. Keep protection in place and intact at
20 least 24 hours after artificial heat is discontinued to allow gradual temperature adjustments. Avoid rapid
21 dry-out of concrete due to overheating. Provide cold weather protection complying with ACI 306.

22 3. When atmospheric temperature is above 80 deg F and during climatic conditions which cause rapid drying
23 of concrete, make arrangements for installation of wind breaks or shading, and for fog spraying, wet
24 sprinkling, or moisture-retaining covering. Protect concrete continuously during curing period. Provide hot
25 weather protection complying with ACI 305.

26 B. Moisture-Retaining Cover: Apply moisture-retaining cover to wet cure concrete surfaces to receive bonded finishes
27 and chemical hardeners, surfaces where curing and sealing compounds would reduce bond of subsequent
28 treatments, and vertical surfaces where formwork is removed prior to end of curing period.

29 C. Curing Compound: Apply white-pigmented membrane curing compound to exterior pavements, walks, curbs, and
30 other slabs, unless otherwise indicated.

31 3.19 REMOVAL OF FORMS

32 A. Remove forms from cast-in-place concrete only after concrete has achieved sufficient strength to support itself and
33 superimposed loads; but in no case in less time than stated below.

34 B. Forms not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may
35 be removed 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form
36 removal operations, and provided that curing and protection operations are maintained.

37 C. Forms supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be
38 removed in less than 14 days, and not until concrete has attained design minimum 28-day compressive strength.

39 D. Form facing material may be removed 4 days after placement if shores and other vertical supports have been
40 arranged to permit removal of form facing material without loosening or disturbing shores and supports.

- 1 3.20 RE-USE OF FORMS
- 2 A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form
3 facing material will not be acceptable. Apply new form coating compound to concrete contact surfaces as specified
4 for new forms.
- 5 B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance,
6 and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed
7 concrete surfaces.
- 8 C. When using board forms for architectural pattern finish, replace all boards with tie holes before each use.

9 PART 4 - PART 4 SCHEDULES

10 4.1 CLASSES OF CONCRETE

11	12	13	14	15	16	17	18	19
	Class	Min. Comp. Strength @ 28 days, p.s.i.	Max. Slump	Max. Agg. Size	Min. Cement, Bags/ C.Y.**	Max. Water- Cement Ratio	Air Content, % By Volume	
15	AA	4500	3-1/2"	3/4"*	6	0.45	5-7%*	
16	A	4000	3-1/2"	3/4"	6	0.48	1-3%	
17	BB	3000	3-1/2"	3/4"*	5-3/4	0.48	5-7%*	
18	* 1-1/2" max. aggregate size may be used if allowed by ACI 318. If used, air-entrainment shall be 4-6%.							
19	** Fly ash may be used to constitute up to 30% by weight of total cementitious material.							

20 4.2 USAGE SCHEDULE

21 A. Use class scheduled below, unless otherwise shown.

22	Usage/Application	Min. Class
23	Footings, 48 in. +/- foundation (frost) walls.....	A
24	Exterior slabs, stairs, steps, ramps, equipment pads	AA
25	Sidewalks, curbs, driveways, pavements	AA
26	Fence, sign post, and flagpole bases	BB
27	Retaining wall.....	AA

28 END OF SECTION

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1 SECTION 321605 – CONCRETE CURBS, GUTTERS, WALKS, AND DRIVES
2 GENERAL

3 1.1 RELATED DOCUMENTS

4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 B. The City of Madison Standard Specifications for Public Works Construction, current edition.

7 1.2 SUMMARY

8 A. Section Includes:

- 9 1. Concrete curbs, gutters, walks, and drives as shown and as specified.
10 2. Comply with applicable laws and regulations for work on public property.

11 B. Related Requirements:

- 12 1. Section 321610 Site Cast-In-Place Concrete.
13 2. Section 310510 Site Preparation.
14 3. Section 312000 Earth Moving.

15 1.3 SUBMITTALS

16 A. Product Data: For each type of product indicated.

17 B. Samples: For each exposed product and for each color and texture specified

18 C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of
19 materials, project conditions, weather, test results, or other circumstances warrant adjustments.

20 1.4 CODES AND STANDARDS

21 A. Comply with the following codes and standards, except as otherwise designated:

- 22 1. ACI 301 Specifications for Structural Concrete.
23 2. ASTM C 94/C 94m

24 PART 2 - PRODUCTS

25 2.1 FORMS

26 A. Forms may be either stationary or slip-form type. If slip forms are used, finished curb and gutter shall be of quality
27 equal to that produced by stationary forms.

1 B. Stationary forms shall be steel or wood, free of distortion and defects, and of appropriate size and strength. Use
2 flexible spring steel forms or laminated boards to form radius bends. Apply nonstaining, clear, paraffin-based form
3 oil.

4 2.2 REINFORCEMENT

5 A. Plain-Steel Welded Wire Reinforcement shall comply with ASTM A 185A 185M, fabricated from as-drawn steel wire
6 into flat sheets

7 B. Deformed-Steel Welded Wire Reinforcement shall comply with ASTM A 497/A 497M, flat sheet.

8 C. Reinforcement bars shall comply with ASTM A615, Grade 60; deformed.

9 D. Plain-Steel Wire shall comply with ASTM A 82/A 82M, as drawn.

10 E. Deformed-Steel Wire shall comply with ASTM A 496/A 496M.

11 F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars,
12 welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of
13 Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete
14 specified.

15 2.3 EXPANSION JOINT FILLER

16 A. Premolded joint filler, ASTM D1751, asphalt saturated cellulosic fiber; 1/2-in. thickness by depth of concrete, unless
17 otherwise shown.

18 2.4 CURING COMPOUND

19 A. Liquid membrane-forming compound, ASTM C309, Type 2, white-pigmented.

20 2.5 CONCRETE

21 A. Comply with requirements of Section 321610 Cast-In-Place Concrete, Class AA.

22 PART 3 - EXECUTION

23 3.1 PREPARATION

24 A. Remove loose material from compacted subgrade. Proof-roll subgrade; give notice of unstable areas. Moisten
25 subgrade to provide a uniformly damp condition.

26 B. Set clean forms to required grades and lines, rigidly braced and secured. Provide minimum concrete thicknesses as
27 indicated on Drawings.

28 C. Place and support steel reinforcement as specified in Section 03 20 00 / 03 30 00.

29 D. Check tolerances as follows (slip form methods shall produce equivalent results):

30 1. Top of form: 1/8 in. in 10 ft.

- 1 2. Alignment of vertical face: 1/4 in. in 10 ft.
- 2 3.2 EDGE FORMS AND SCREED CONSTRUCTION
- 3 A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and
4 elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours
5 after concrete placement.
- 6 B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
- 7 3.3 JOINTS
- 8 A. Construct joints true-to-line with face perpendicular to surface. Construct transverse joints at right angles to
9 centerline, unless otherwise shown.
- 10 B. At abutting existing walks, align transverse joints with previously placed joints, unless otherwise shown.
- 11 C. Provide weakened-plane (contraction) joints for a depth equal to at least 1/4 the curb, gutter, walk, or drive
12 thickness.
- 13 1. Locate joints in curbs and gutters at 20 ft on center, unless otherwise shown.
14 2. Locate joints in walks and drives as detailed on Drawings.
- 15 D. Place construction joints at end of all pours and when operations are stopped for more than 1/2 hr. Use standard
16 metal keyway section forms for joints not shown on drawings.
- 17 E. Provide premolded joint filler for expansion joints and isolation joints abutting fixed objects. Provide expansion
18 joint filler between abutting curbs and walks. Locate additional expansion joints at maximum of 100 ft on center,
19 unless otherwise shown. Extend joint fillers full width and depth of the joint, set 1/2 to 1 in. below finished surface.
20 Conform to profile of concrete surface. Furnish joint fillers in one-piece lengths wherever possible; otherwise lace
21 or clip joint filler sections together. Protect top edge of joint filler during concrete placement.
- 22 3.4 CONCRETE PLACEMENT
- 23 A. Mix, place, cure, and protect concrete in accordance with Section 033000 Cast-In-Place Concrete.
- 24 B. After striking off and consolidating concrete, smooth surface by screeding and floating. Test surface for trueness
25 with a 10 ft straightedge. Remove surface irregularities and refloat repaired areas to provide a continuous, smooth
26 finish of uniform texture.
- 27 C. Work edges of slabs and joints with edging tool to form a 1/4 in. radius.
- 28 D. After floating and when excess moisture has disappeared, provide broom finish by drawing a fine-hair broom
29 perpendicular to direction of travel.
- 30 E. After 24 hours, remove forms, clean ends of joints, and point-up honeycombed areas.
- 31 3.5 PAVING TOLERANCES
- 32 A. Comply with tolerances in ACI 117 and as follows:
- 33 1. Elevation: 3/4 inch.

- 1
 - 2
 - 3
 - 4
 - 5
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot-long, unlevelled straight edge not to exceed 1/2 inch.
 4. Joint Spacing: 3 inches.
 5. Contraction Joint Depth: Plus 1/4 inch, no minus.
 6. Joint Width: Plus 1/8 inch, no minus.

6 B.

7 3.6 REPAIR AND PROTECTION

8 A. Repair or replace broken or defective concrete or concrete that does not comply with requirements in this Section.
9 Remove work in complete sections from joint to joint unless otherwise approved by A/E. Remove surface stains.
10 Exclude traffic from concrete until the specified curing period is complete (generally 7 days). Protect concrete from
11 damage until Substantial Completion.

12 B. Prior to final inspection, sweep concrete and wash free of stains, dirt, and other foreign material.

13 END OF SECTION

1 SECTION 323160 – WOOD FENCES AND GATES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes:

- 8 1. Construction and installation of wood fences and gates as shown and as specified in the Drawings.

9 1.3 SUBMITTALS

- 10 A. Color Charts: Submit color chart of stain samples in accordance with contract documents.

11 1.4 QUALITY STANDARDS

- 12 A. Comply with U.S. Dept. of Commerce PS 20, American Softwood Lumber Standard, and with applicable grading rules
13 of the respective grading and inspecting agency for the species and product indicated.

14 1.5 DELIVERY, STORAGE, AND HANDLING

- 15 A. Do not deliver lumber or trim until suitable storage is available on site; take care to avoid moisture buildup. Store in
16 accordance with good practice to avoid warp, damage, soiling and deterioration.

17 PART 2 - PRODUCTS

18 2.1 FENCE BOARDS, POSTS, AND RAILS

- 19 A. Pressure preservative treated western red cedar, Grade No. 2 or better.

20 2.2 MISCELLANEOUS HARDWARE

- 21 A. Furnish miscellaneous hardware including but not limited to nails, screws, bolts, toggle bolts, staples, angles, and
22 other appurtenances. Anchor bolts shall be galvanized steel expansion type, FS FF-S-325, minimum 1500 lb pullout;
23 Hilti, ITW Ramset/Red Head, Simpson Strong-Tie, Wej-it, or equal.

- 24 B. Angles and other metal fabrications shall be primed and painted with two coats of an exterior grade flat enamel.

- 1 2.3 FINISH
- 2 A. Finish all wood members with two coats of semi-transparent exterior stain; PPG/Olympic, or equal.
- 3 PART 3 - PART 3 EXECUTION
- 4 3.1 INSTALLATION
- 5 A. Install wood fencing plumb, level, true, and straight with no distortions.
- 6 END OF SECTION

1 SECTION 323300 – SITE FURNISHINGS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Provide site furnishings as shown and as specified.

9 1.3 SUBMITTALS

- 10 A. Product Data: Submit product data for each type of site furnishing.

- 11 B. Samples: Submit samples for each color finish for selection by A/E.

- 12 C. Make submittals in accordance with contract documents.

13 1.4 QUALITY ASSURANCE

- 14 A. Source Limitations: Obtain each type of site furnishing from a single source with resources to provide components
15 of consistent quality in appearance and physical properties.

16 PART 2 - PRODUCTS

17 2.1 BICYCLE RACKS

- 18 A. Acceptable Product: Saris Parking "Post and Ring Rack", or approved equal.

- 19 B. Description:

- 20 1. Materials: Nominal 1.5 in. square Sch. 40 steel tube.
21 2. Overall Height and Width: Approximately 33 in. x 21 in.
22 3. Steel Finish: Powder coated.
23 4. Finish Color: Black.

- 24 C. Installation Type: Flange mount. Include four stainless steel anchor bolts per mounting plate. Install per
25 manufacturer's recommendations.

- 1 2.2 PLANTERS
- 2 A. Tectura Designs "WS-501", or approved equal.
- 3 B. Description:
- 4 1. Reinforced aluminum planter.
- 5 2. 30 in. long x 30 in. wide x 30 in. high.
- 6 3. Finish Color: 126 Charcoal.
- 7 C. Installation Type: Freestanding.

8 PART 3 - EXECUTION

9 3.1 INSTALLATION, GENERAL

- 10 A. Install permanently-mounted site furnishings at locations designated. Mount furnishings plum and level. Comply
- 11 with manufacturer's written installation instructions. Complete field assembly of site furnishings when required.
- 12 B. Deliver freestanding site furnishings to project site just prior to substantial completion. Complete field assembly of
- 13 site furnishings when required.

14 END OF SECTION

1 SECTION 323974 – REGULATORY SIGNS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

- 8 1. Provide traffic and parking signs as shown and as specified.

9 1.3 DEFINITIONS

- 10 A. References to "WIDOT Std. Spec." shall mean Wisconsin Department of Transportation, Standard Specifications for
11 highway and Structure Construction, latest edition.

12 1.4 SUBMITTALS

- 13 A. Shop Drawings: Submit shop drawings for all signs. Show type of sign, materials, dimensions, colors, text, graphics,
14 and method of attachment.

15 1.5 DELIVERY, STORAGE, AND HANDLING

- 16 A. Ship sign materials and attachment devices carefully packaged to prevent surface damage. Include shop drawings
17 and templates to insure correct installation and arrangement of all materials.

18 PART 2 - PRODUCTS

19 2.1 HANDICAPPED PARKING SIGNS

- 20 A. Minimum 12 in. x 18 in. x 18 ga cold rolled galvanized steel, treated for a baked enamel finish. Colors, text and
21 design shall meet Wis. Adm. Code.

- 22 B. Signs shall be mechanically mounted to poles with aluminum, vandal proof hardware. See details.

23 2.2 TRAFFIC SIGNS

- 24 A. Traffic signs shall comply with the requirements of WIDOT Std. Spec., Section 637, for Type II Reflective Signs.
25 WIDOT vandalism sticker is not required.

- 26 B. Sign dimensions and message shall be as detailed on Drawings.

1 2.3 SIGN POSTS

2 A. Wood posts complying with the requirements of WIDOT Std. Spec., Section 634.

3 PART 3 - EXECUTION

4 3.1 INSTALLATION

5 A. Install signs in accordance with manufacturer's instructions, shop drawings, and setting templates.

6 B. Signs shall be set plumb and level.

7 C. Touch-up any abrasions to finish. Completely clean signs of all foreign matter.

8 END OF SECTION

1 SECTION 328400 – PLANTING IRRIGATION

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

7 A. Section Includes:

- 8 1. This section specification information is for a low volume dripline irrigation system and design.
9 2. Provide labor, materials, supplies, equipment, tools, and transportation, and perform all operations in
10 connection with and reasonably incidental to the complete the design and installation of the drip irrigation
11 system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein.
12 3. Unless otherwise designated include everything necessary for a complete irrigation system installation.
13 Coordinate with work of other trades.

14 B. Related Sections:

- 15 1. Section 321605 Concrete Curbs, Gutters, Walks, and Drives.
16 2. Section 312000 Earth Moving.
17 3. Section 329200 Turf and Grasses.
18 4. Section 329236 Native Species Seeding.
19 5. Section 329300 Plants.
20 6. Division 22 – Plumbing.
21 7. Division 26 – Electrical.

22 1.3 SUBMITTALS

23 A. Prebid Submittals: Product Requirements. Submit following with bid.

- 24 1. Substitution data.

25 B. Submittals for Review:

- 26 1. Product data.
27 2. Shop drawings.
28 3. Permits and Approvals: Submit copies of permits and code approvals.
29 4. Delegated-Design Submittal: Submit statement, signed and sealed by responsible design professional, for
30 each product and system specifically assigned to Contractor to be designed or certified by a design
31 professional, indicating that products and systems are in compliance with performance and design criteria
32 indicated. Include list of codes, loads, and other factors used in performing these services.
33 5. Submittals Schedule.

34 C. Quality Assurance/Control Submittals: E/A's response is not required.

- 35 1. Design Data calculations for irrigation system
36 2. Certificates and Certifications
37 3. Test and Inspection Reports:

- 1 4. Commitment to Warrant: Before starting work of this Section, submit with Shop Drawings and Product
- 2 Data, manufacturer's signed statement that design and specifications are correct for this Project, and that
- 3 when product is installed as specified, manufacturer's warranty will be enforceable.
- 4 5. Manufacturer's Installation Instructions.
- 5 6. Installer Qualifications: Document qualifications of company and supervisory personnel proposed to
- 6 perform work of this Section; include list of previous similar installations.

- 7 D. Contract Closeout Submittals:

- 8 1. Project record documents.

- 9 a. Submit record drawings showing complete layout of sprinkler heads, valves, drains, and pipe lines.
- 10 Record horizontal and vertical dimensions to all items from permanent reference points. Make and
- 11 record measurements to nearest 0.5 ft.

- 12 2. Operation and maintenance data.
- 13 3. Warranty: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name
- 14 and registered with manufacturer.

- 15 1.4 FLUSHING AND TESTING

- 16 A. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct line flushing and testing
- 17 procedures.

- 18 B. Dripline and Emitter Lateral Flushing Procedures.

- 19 1. Flush the system every two weeks for the first six (6) weeks and check the water that is flushed out for
- 20 cleanliness. Establish a regular system flushing schedule for the future based on results from the initial six-
- 21 week flushing schedule.
- 22 2. Flush the system completely after any repairs are made and monitor system operation closely under regular
- 23 system flushing schedule.
- 24 3. Check the pressure at the supply and flush headers on a regular basis and compare with the pressure
- 25 readings taken after installation.

- 26 C. Dripline and Emitter Lateral Leakage Testing Procedures.

- 27 1. Subject installed dripline tubing and emitter lateral piping to water pressure equal to specified operating
- 28 pressure for ten (10) minutes. Test with control zone components and dripline flush valve components
- 29 installed.
- 30 2. Partially backfill buried pipe and tubing to prevent movement under pressure. Expose couplings, fittings,
- 31 and valve components.
- 32 3. Visually inspect valve assemblies and fittings for leakage and replace defective pipe, fitting, joint, valve, or
- 33 appurtenance. Repeat test until test segment is free from leaks. Cement or caulking to seal leaks is
- 34 prohibited.

- 35 D. Dripline and Emitter Lateral Operational Testing Procedures.

- 36 1. Activate each dripline and emitter lateral control zone valve in sequence from controller. Provide either one
- 37 additional person with radio or use handheld remote to activate remote control valves from controller.
- 38 Manually activating remote control valve using manual bleed mechanism at remote control valve is not an
- 39 acceptable method of activation. Owner's Representative will visually observe operation, water application
- 40 patterns, and leakage.
- 41 2. Replace or adjust defective valve, fitting, dripline segment, emitter lateral segment, or appurtenance to
- 42 correct operational and coverage uniformity deficiencies.
- 43 3. Repeat test(s) until each dripline or emitter lateral test segment passes testing procedures. Repeat tests,
- 44 replace components, and correct deficiencies at no additional cost to Owner and/or Owner's
- 45 Representative.

- 1 1.5 PERMITS, LICENSES, AND CERTIFICATES
- 2 A. Procure permits and licenses, pay all charges and fees, and give notices necessary for proper and lawful prosecution
3 of work. Obtain certificates required to show that work has been performed in accordance with applicable codes,
4 rules, and regulations.
- 5 B. Arrange and pay for inspections required for work under this section.

6 **PART 2 - PRODUCTS**

7 2.1 DESIGN REQUIREMENTS

- 8 A. Provide design for a drip irrigation system in the areas as shown on the Drawings.
- 9 B. Size zones to meet headloss requirements based on the supply line.

10 2.2 MATERIALS, GENERAL

- 11 A. The same brand or manufacturer shall be used for each specific application of pumps, valves, fittings, controls, and
12 other equipment.
- 13 B. All materials shall be new and of the quality specified.
- 14 C. All equipment shall be listed, approved, or rated by a nationally recognized testing and rating bureau of recognized
15 manufacturers association responsible of setting industry standards. All electrical equipment and apparatus shall
16 be U.L. listed.
- 17 D. Acceptable sprinkler system manufacturers are Hunter, Rainbird, Toro, or approved equal.

18 2.3 LATERAL PIPE AND FITTINGS

- 19 A. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe,
20 extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784,
21 with integral belled end suitable for solvent welding.
- 22 B. Use Class 160, SDR-26, rated at 160 PSI (11 bar), conforming to dimensions and tolerances established by ASTM
23 Standard D2241. Use PVC pipe rated at higher pressures than Class 160 in cases where small nominal diameters are
24 not manufactured in Class 160.

25 (or)

26 Use Class 200, SDR-21, rated at 200 PSI (13,8 bar), conforming to dimensions and tolerances established by ASTM
27 Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the cases where small nominal diameters
28 are not manufactured in Class 200.

29 (or)

30 Use Schedule 40 conforming to dimensions and tolerances established by ASTM Standard D1785; UV radiation
31 resistant.

- 32 C. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe.
33 Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved
34 by pipe manufacturer.
- 35 D. Use PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings for threaded pipe connections as
36 specified on the drawings and details.

1 E. Threaded joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded
2 connections and approved by pipe fitting or valve manufacturer.

3 2.4 DRIP IRRIGATION COMPONENTS

4 A. Control Zone Kits

5 1. General Information

6 a. Control zone kit assemblies for dripline irrigation zones must include control valve, filtration, and
7 pressure regulation components sized to meet the hydraulic demands and flow requirements of the
8 zones that they service.

9 B. Dripline Components

10 1. General Information

11 a. Provide flexible dual-layered pressure-compensating inline Dripline with emitter spacing and
12 dripline row spacing as indicated on construction drawings.

13 b. Provide insert or compression fittings that are compatible with inline emitter.

14 2. On-Surface Dripline with pressure-compensating inline emitters.

15 a. Dripline tubing material and performance specifications include:

16 1) Tubing; dual-layered, brown in color, conforming to an outside diameter (O.D.) of 0.634
17 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of
18 0.049 inches (1,2 mm)

19 2) Factory installed, pressure-compensating, inline emitters welded to the inner circumference
20 of the polyethylene tubing at spacing specified by manufacturer.

21 3) Inline emitters designed to pressure-compensate.

22 4) Consistent flow rate from each installed inline emitter when emitter inlet pressure is
23 supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)

24 5) Manufacturer's recommended filtration for dripline tubing and emitters

25 3. Dripline with Heavy-Duty Check Valve and pressure-compensating inline emitters.

26 a. Required dripline tubing material and performance specifications include:

27 1) Tubing; dual-layered, brown in color, conforming to an outside diameter (O.D.) of 0.634
28 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of
29 0.049 inches (1,2 mm)

30 2) Inline emitter that includes a 3.5psi check-valve to facilitate 8ft of holdback

31 3) Factory installed, pressure-compensating, inline emitters welded to the inner circumference
32 of the polyethylene tubing at spacing specified by model number

33 4) Inline emitters designed to pressure-compensate)

34 5) Consistent flow rate from each installed inline emitter when emitter inlet pressure is
35 supplied between recommended operating range of 8.5 to 60 PSI (0,7 to 4,1 bar)

36 6) Manufacturer's recommended filtration for dripline tubing and emitters

37 4. Sub-Surface Copper-Colored Dripline and pressure-compensating inline emitters.

38 a. Dripline tubing material and performance specifications:

39 1) Copper-colored, dual layered tubing conforming to an outside diameter (O.D.) of 0.634
40 inches (16 mm) and an inside diameter (I.D.) of 0.536 inches (13,6 mm) and wall thickness of
41 0.049 inches (1,2 mm)

- 1 2.10 AUTOMATIC CONTROLLER
- 2 A. Low voltage, solid state controller manufactured expressly for control of automatic valves for lawn sprinkler
3 systems.
- 4 1. Provide a controller with minimum of 12 stations.
5 2. Include a remote control system for the irrigation system utilizing a hand held radio controller.
- 6 B. Controller shall have capacity to assign from 5 minutes to 60 minutes of run time to any station and shall have a
7 minimum of two programs. Timing shall be accomplished by solid state means.
- 8 C. Controller shall have choice of scheduling on basis of seven-day calendar, 1 to 7day interval, and odd/even with 365
9 day calendar. Include a moisture sensor or other water conservation system to shut off water during rain.
- 10 D. A pump/master valve circuit shall be provided to activate a remote pump start relay to run pump during sprinkling
11 cycle or to use with a master valve to pressurize system during sprinkling cycle.
- 12 2.11 CONTROL WIRE
- 13 A. Electric control lines from controller to automatic valves shall be 24 volt solid, direct burial wire, minimum 14 gage.
- 14 2.12 BACKFLOW PREVENTER
- 15 A. Reduced pressure type backflow preventer complying with ASSE 1013 and meeting requirements of State Plumbing
16 Code for the application.
- 17 **PART 3 - EXECUTION**
- 18 3.1 INSPECTIONS AND REVIEWS
- 19 A. Pre-construction Site Inspection
- 20 B. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities in
21 writing to Owner's Representative prior to beginning work. Commencement of work implies acceptance of existing
22 site conditions.
- 23 C. Utility Locates
- 24 1. Arrange and coordinate Utility Locates with local authorities prior to construction.
25 2. Repair underground utilities that are damaged during construction. Make repairs at no additional cost to
26 contract price.
- 27 3.2 EXCAVATING AND BACKFILLING
- 28 A. Excavate as required for the proper installation of work.
- 29 B. Backfill trenches with material free from rock, large stone or other material which may damage pipe. Backfilling
30 shall be in accordance with Section 31 20 00. Backfill material shall be compacted in 6 in. layers to finish grade.
- 31 C. Backfill of trenches containing plastic piping when pipe is cool.
- 32 3.3 PIPE INSTALLATION
- 33 A. Underground pipe shall be installed with a minimum depth of cover of 18 in. for main lines under constant pressure
34 and 12 in. for lateral lines.

- 1 B. Install pipe in accordance with manufacturer's recommendation.
- 2 C. Securely cap piping at the end of each day's work to prevent entrance of foreign material. Flush piping before
3 installation of heads and valves.
- 4 3.4 VALVE AND ACCESSORY INSTALLATION
- 5 A. A. Install buried valves in valve boxes. Provide union on downstream side. Locate valves at least 12 in. from walks,
6 buildings, walls, and other boundaries.
- 7 B. Install winterizing system.
- 8 3.5 AUTOMATIC CONTROLLER AND WIRING INSTALLATION
- 9 A. Locate controller to be determined at jobsite by Architect.
- 10 B. Label control lines at controller with permanent non-fading labels indicating identification number of valve
11 controlled.
- 12 C. Run wiring along supply line piping wherever practical. Tie wires in bundles at 10 ft intervals. Place on bottom side
13 of pipe (minimum depth of 12 in.).
- 14 D. Run control wire to each valve without interruption. Common wires may be spliced at valves only.
- 15 E. Make connections and splices by crimping base wires with brass connectors and sealing with epoxy resin sealer
16 packs.
- 17 F. Provide 24 in. minimum wiring loop at each control valve and splice location. Coil loops neatly in boxes.
- 18 3.6 CASING PIPES (SLEEVING)
- 19 A. Pipe and wiring passing under existing or future paving and other construction shall be encased in PVC plastic casing
20 pipe extending at least 12 in. beyond edges of paving or construction. Minimum cover on casing pipes shall be 12
21 in.
- 22 3.7 TESTS AND ADJUSTMENTS
- 23 A. Conduct tests of systems as required by codes, regulatory agencies, and this specification. Notify Architect and
24 regulatory agencies prior to conducting tests.
- 25 B. Apply a hydrostatic test of 100 psi to main line (pump/master valve to control valves).
- 26 C. Test complete system under full line pressure.
- 27 D. All necessary testing equipment shall be furnished by Contractor.
- 28 3.8 DRIPLINE LAYOUT OF WORK
- 29 A. Stake out dripline irrigation system. Items staked include manifold/header pipe and tubing, sleeves, control zone
30 assemblies, flush valves, air relief valves, and check valves.
- 31 B. Dripline Irrigation System Layout Review: Dripline irrigation system layout review will occur after staking has been
32 completed. Notify Owner's Representative one week in advance of review. Modifications will be identified by
33 Owner's Representative at this review.

- 1 3.9 DRIPLINE EXCAVATION, TRENCHING, AND BACKFILL
- 2 A. Excavate and install pipes at minimum cover indicated in drawings or specifications. Excavate trenches at
3 appropriate width for connections and fittings.
- 4 B. Minimum cover for dripline components (distance from top of pipe to finish grade):
- 5 1. Buried PVC manifold and supply header pipe to dripline grid layouts: 12" (30,5 cm) to top of pipe.
6 2. Buried dripline lateral pipe downstream PVC manifold and supply header pipe: 4" (10 cm) to top of pipe
7 3. On-grade dripline lateral pipe downstream PVC manifold and supply header pipe: Secure to finish grade
8 with approved tubing stakes. Install and test prior to installation of landscape fabric and mulch.
- 9 C. Backfill only after buried lines have been reviewed, tested, and approved.
- 10 D. Excavated material is generally satisfactory for backfill. Use backfill free from rubbish, vegetable matter, frozen
11 materials, and stones larger than 2" (50 mm) in maximum diameter. Remove material not suitable for backfill. Use
12 backfill free of sharp objects next to pipe.
- 13 E. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades. Dispose of excess
14 backfill off site.
- 15 F. Contact Architect for trench depth adjustments where utilities conflict with irrigation trenching and pipe work.
- 16 3.10 ASSEMBLING PIPE AND FITTINGS
- 17 A. General:
- 18 1. Keep pipe free from dirt and debris. Cut pipe ends square, debur and clean as recommended by pipe
19 manufacturer.
20 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
- 21 B. PVC Pipe and Fittings:
- 22 1. Use only strap-type friction wrenches for threaded plastic pipe.
23 2. PVC Solvent Weld Pipe and Fittings:
- 24 a. Use appropriate primer and solvent cement. Join pipe in manner recommended by pipe and fitting
25 manufacturers and in accordance with accepted industry practices.
26 b. Cure for thirty (30) minutes before handling and twenty-four (24) hours before pressurizing or
27 installing with vibratory plow.
28 c. Snake pipe from side to side within trench.
- 29 3. PVC Threaded Connections:
- 30 a. Use only factory-formed threads. Field-cut threads are not permitted.
31 b. Apply thread sealant in manner recommended by component, pipe and sealant manufacturers and
32 in accordance with accepted industry practices.
- 33 C. Dripline Tubing and Fittings:
- 34 1. Use only dripline tubing connections or transitions as recommended by the Manufacturer's representative
35 for the specific site and system conditions.
36 2. Dripline Insert Fittings:
- 37 a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with
38 accepted industry practices.

- 1 3. Dripline Compression Fittings:
- 2 a. Install dripline tubing and fittings in manner recommended by manufacturer and in accordance with
- 3 accepted industry practices.
- 4 3.11 INSTALLATION OF DRIPLINE IRRIGATION COMPONENTS
- 5 A. Control Zone Kit Assembly:
- 6 1. Flush mainline pipe before installing Control Zone Kit assembly.
- 7 2. Locate where shown on drawings. Connect control wires to remote control valve wires using specified wire
- 8 connectors and waterproof sealant. Provide connectors and sealant per manufacturer's recommendations.
- 9 3. Install a maximum of four (4) Low Flow or Medium Flow Control Zone Kits per standard rectangular valve
- 10 box. Install a maximum of one (1) Medium Flow Commercial Control Zone Kits per standard rectangular
- 11 valve box. Install a maximum of one High Flow Commercial Control Zone Kits per jumbo rectangular valve
- 12 box.
- 13 a. Locate valve boxes at least 12" (30,5 cm) from, and align with, nearby walls or edges of paved areas.
- 14 b. Group Control Zone Kit assemblies together where practical. Align grouped valve boxes in uniform
- 15 patterns. Allow at least 12" (30,5 cm) between valve boxes.
- 16 c. Brand controller letter and station numbers on valve box lid in 2" (50 mm) high letters.
- 17 B. Lateral Piping and Dripline Tubing:
- 18 1. Install lateral piping and dripline tubing at locations and in grid patterns as indicated on drawings and
- 19 installation details, and in strict accordance with manufacturer recommendations.
- 20 2. Thoroughly flush PVC lateral piping, supply headers, and dripline tubing immediately upon installation.
- 21 C. Air Relief Valve Kit Assembly: Install at all high points in dripline tubing grid as shown and directed on drawings and
- 22 installation details.
- 23 D. Flush Point Assembly: Install in flush header or at ends of each dripline zone segment as shown and directed on
- 24 drawings and installation details. Install at least 12-inches from and align with adjacent walls or edges of paved
- 25 areas.
- 26 3.12 PROJECT RECORD (AS-BUILT) DRAWINGS
- 27 A. Document field changes from original design and construction documents. Maintain on-site and separate from
- 28 original construction documents, one complete set of documents labeled "Project Field Documents". Keep
- 29 documents current. Do not permanently cover work until accurate "as-built" information is recorded.
- 30 B. Record pipe network alterations on a daily basis. Record work that is installed differently than shown on
- 31 construction documents. Record accurate reference dimensions, measured from at least two permanent reference
- 32 points, of each control zone kit assembly, each dripline zone boundary, each air relief valve assembly, each flush
- 33 point assembly, and other dripline irrigation components enclosed within valve box.
- 34 3.13 WINTERIZATION AND SPRING START-UP
- 35 A. Winterize irrigation system in fall following completion, or partial completion, of irrigation system construction.
- 36 Start-up irrigation system in spring following completion, or partial completion, of irrigation system construction.
- 37 Repair any damage caused in improper winterization at no additional cost to Owner. Coordinate winterization and
- 38 start-up with landscape maintenance personnel.

- 1 3.14 MAINTENANCE
- 2 A. Maintain irrigation system for duration of 30 calendar days from formal written acceptance by Architect. Make
3 periodic examinations and adjustments to irrigation system components in order to achieve the most efficient and
4 uniform application of water.
- 5 B. Following completion of Contractor's maintenance period, Owner will be responsible for maintaining system in
6 working order during remainder of guarantee/warranty period, for performing necessary minor maintenance, for
7 protecting against vandalism, and for preventing damage after landscape maintenance operation.
- 8 3.15 CLEANUP
- 9 A. Remove from site machinery, tools, excess materials, and rubbish upon completion of work.
- 10 END OF SECTION

1 SECTION 329200 – TURF AND GRASSES

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

8 1. Preparation of turf areas, seeding, and replanting unsatisfactory growth.

- 9 B. Related Requirements:

- 10 1. Section 310510 Site Preparation.
11 2. Section 315639 Temporary Tree and Plant Protection.
12 3. Section 329236 Native Species Seeding.
13 4. Section 329300 Plants.

14 1.3 DEFINITIONS

- 15 A. A. References to "WIDOT Std. Spec." shall mean Wisconsin Department of Transportation, Standard Specifications
16 for Highway and Structure Construction, latest edition.

17 1.4 SUBMITTALS

- 18 A. Product Data: Submit product labels for fertilizer and seed mixtures proposed for use on project.

19 B. Maintenance Instructions: Prior to Substantial Completion, submit two copies of typewritten instructions
20 recommending procedures to be established by Owner for maintenance of turf and grass work during first year
21 after completion of work.

- 22 C. Make submittals in accordance with the contract documents.

23 1.5 WORK SEASONS

- 24 A. Conduct work during favorable weather conditions between April 15 and September 15. Do not proceed when air
25 temperatures may exceed 90 deg F or when ground surface is frozen, except seeding may be performed in
26 November prior to snow cover if seed is applied over mulch that was placed during period from September 15 to
27 November 1.

1 PART 2 - PRODUCTS

2 2.1 TOPSOIL

3 A. Loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing surface soil; 100% passing the 2 in. sieve;
4 neither excessively acid, nor excessively alkaline; reasonably free of subsoil, clay lumps, brush, and weeds; and free
5 of extraneous matter harmful to plant growth.

6 B. Reuse topsoil salvaged from within work area. If necessary, obtain topsoil to supplement insufficient quantities at
7 site from naturally well-drained local sources; do not obtain from bogs or marshes.

8 2.2 FERTILIZER

9 A. Solid or liquid form, commercial fertilizer. If using a solid form of fertilizer, use products with a SGN (Size Guide
10 Number) of 200 or less.

11 1. Composition of Fertilizer: Phosphorus-free fertilizer with a minimum of 30 percent nitrogen and 10 percent
12 potash, by weight.

13 2.3 STAKES

14 A. Lath or shingles, pointed, 6 in. long.

15 2.4 GRASS SEED

16 A. General: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing
17 Seeds" for purity and germination tolerances. Deliver seed in bags tagged and labeled to show percentage of purity
18 and germination. Seed shall have been tested within one year prior to date of seeding and shall conform to latest
19 State and Federal seed laws.

20 B. Grass seed mixtures shall be as follows:

21 1. City of Madison's No-Mow Mix.

22 2.5 STRAW MULCH

23 A. Straw or hay, reasonably free of grain, weed seed or mold. Mulch materials shall not contain excessive moisture
24 which prevents uniform feeding through mulching machine.

25 2.6 TACKIFIER

26 A. Non-asphalt-based tackifier intended for use in anchoring mulch.

27 2.7 MULCH NET

28 A. Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq yd minimum, with 50 to 65 percent open area. Include
29 manufacturer's recommended biodegradable staples, 6 in. long.

- 1 2.8 EROSION MAT
- 2 A. Erosion mat complying with WIDOT Std. Spec., Section 628, and WIDOT Erosion Control Product Acceptability List
3 (PAL) for class and type of erosion mat indicated on the Drawings. If not indicated provide Class I, Type B, erosion
4 mat.
- 5 PART 3 - EXECUTION
- 6 3.1 PROTECTION
- 7 A. Protect improvements from damage and new pavements from tire markings caused by turf preparation and
8 planting operations.
- 9 3.2 SUBGRADE PREPARATION AND TOPSOIL PLACEMENT
- 10 A. Prior to topsoil placement, loosen existing subgrade to a depth of 4 in. Remove stones larger than the maximum
11 size allowed for topsoil, along with sticks, roots, rubbish, and other extraneous matter and legally dispose of them
12 off the Owner's property.
- 13 B. Remove all growth of vegetation from subgrade prior to topsoil placement.
- 14 C. Place a minimum of 6 in. of topsoil over areas to receive lawn seed or sod. Place a minimum of 18 in. of topsoil over
15 landscaping areas not using special soil compositions.
- 16 D. Smooth grade topsoil to eliminate irregularities. Finished topsoil grade shall be 0.5 in. below adjoining grade of any
17 surfaced area.
- 18 3.3 SOIL PREPARATION
- 19 A. Rake out surface irregularities; remove rocks and hard soil clods. In maintained commercial and residential lawn
20 areas, topsoil shall be hand raked to a smooth, even finish by a qualified landscaper.
- 21 B. Apply initial application of fertilizer onto topsoil prior to seeding. Apply by broadcast spreader at rate to achieve 2.0
22 lb of nitrogen per 1,000 sq ft.
- 23 3.4 MULCH BEDS
- 24 A. Construct mulch beds where shown, minimum 3 in. thick over vegetation barrier, unless otherwise shown. Install
25 edging as detailed.
- 26 3.5 SEEDING
- 27 A. General: Apply seed by broadcast or drilled methods to insure uniform distribution. Cross area in two directions,
28 applying 1/2 of seed in each crossing. Rake seed lightly into top 1/8 in. of soil, roll lightly, and water with fine spray.
- 29 B. Apply seed mixtures at the following rates:
- 30 1. In accordance with City of Madison specifications for No-Mow Mix.

- 1 3.6 PROTECTION OF SEEDED AREAS
- 2 A. Level Areas and Slopes of 3H:1V or Less: Apply straw mulch uniformly in all seeded areas at rate of 1-1/2 tons per
3 acre to a loose depth of 1 to 2 in.
- 4 1. Anchor mulch used for residential, commercial, and other maintained lawns using non-asphalt-based
5 tackifier or mulch nets installed and stapled according to manufacturer's recommendations.
- 6 B. Slopes Greater Than 3H:1V and where Designated on Drawings: Provide erosion control blankets installed and
7 stapled according to manufacturer's recommendations in all seeded areas.
- 8 C. From April 15 to September 15, mulch shall be applied as soon as possible, but within 3 days after seeding. From
9 September 15 to November 1, mulch may be applied prior to seeding. Suspend mulching operations during periods
10 of excessively high winds.
- 11 3.7 WATERING, FERTILIZING, AND MOWING
- 12 A. Maintain seeded areas until Owner accepts responsibility for maintenance at project substantial completion, but in
13 no case less than the time required to establish turf areas as specified under "Establishment and Replacement"
14 below.
- 15 B. Water turf areas as necessary to assure that seeded areas are maintained in a moist condition. Set watering cycles
16 and rates to maintain a uniform moisture depth of 2 in. during establishment. Balance water cycles and rates to
17 avoid standing water and erosion.
- 18 C. Apply second application of fertilizer at rate to achieve 1.0 lb of nitrogen per 1,000 sq ft. Time second application to
19 prevent placing stress on new seed.
- 20 D. Mow turf and grass areas repeatedly to a height of 2-1/2 in. when growth exceeds 3-1/2 in. during maintenance
21 period.
- 22 3.8 ESTABLISHMENT AND REPLACEMENT
- 23 A. Seeded areas which fail to show satisfactory growth within 30 days after seeding shall be raked, reseeded, fertilized,
24 and protected at Contractor's expense. Areas seeded in fall which fail to show satisfactory growth shall be
25 reseeded, fertilized, and protected the following spring before June 1. Satisfactory growth shall be considered
26 healthy grass growth a minimum of 2-1/2 in. high, with no bare spots larger than 6 in. square and total bare spots
27 not exceeding 2 percent of total seeded area.
- 28 END OF SECTION

1 SECTION 329236 – NATIVE SPECIES SEEDING

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes:

- 8 1. Preparing topsoil, seeding, and mulching areas designated on Drawings to receive native species seeding.
9 2. Maintaining native species seeding for a 1-year period.

- 10 B. Related Requirements:

- 11 1. Section 310510 Site Preparation.
12 2. Section 315639 Temporary Tree and Plant Protection.
13 3. Section 329200 Turf and Grasses.
14 4. Section 329300 Plants.

15 1.3 SUBMITTALS

- 16 A. Product Data: Submit product labels for seed mixtures proposed for use on project.

- 17 B. Maintenance Instructions: Prior to Substantial Completion, submit two copies of typewritten instructions
18 recommending procedures to be established by Owner for maintenance of native species seeding work during first
19 year after completion of work.

- 20 C. Make submittals in accordance with contract documents.

21 1.4 WORK SEASONS

- 22 A. Conduct work during favorable weather conditions between April 15 and September 15. Do not proceed when air
23 temperatures may exceed 90 deg F or when ground surface is frozen, except seeding may be performed in
24 November or early December following ground freeze or light snow falls less than 1 inch, provided the ground has
25 not been frozen for more than 2 weeks and seed is mulched or covered by snow fall immediately following seeding.
26 Comply with seed supplier's recommendations for planting conditions.

1 PART 2 - PRODUCTS

2 2.1 TOPSOIL

3 A. Loam, sandy loam, silty clay loam, or clay loam humus-bearing surface soil; 100% passing the 2 in. sieve; neither
4 excessively acid, nor excessively alkaline; reasonably free of subsoil, clay lumps, brush, and weeds; and free of
5 extraneous matter harmful to plant growth.

6 B. Reuse topsoil salvaged from within work area. If necessary, obtain topsoil to supplement insufficient quantities at
7 site from naturally well-drained local sources; do not obtain from bogs or marshes.

8 2.2 HERBICIDE

9 A. EPA registered and approved glyphosate (N-(phosphonomethyl) glycine) herbicide intended for vegetation removal
10 while preparing seed beds.

11 2.3 NATIVE SEED

12 A. Deliver seed in bags tagged and labeled to show percentage of purity and germination. Seed shall have been tested
13 within 1-year prior to date of seeding and shall conform to latest State and Federal seed laws.

14 B. See Drawings for seed mixes and seeding locations.

15 2.4 COVER CROP

16 A. For Spring Seeding: Oats (*Avena sativa*).

17 B. For Fall Seeding: Winter wheat (*Triticum aestivum*).

18 2.5 STRAW MULCH

19 A. Straw or hay, reasonably free of grain, weed seed or mold. Mulch materials shall not contain excessive moisture
20 which prevents uniform feeding through mulching machine.

21 2.6 FIBER MULCH

22 A. Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with
23 a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

24 2.7 TACKIFIER

25 A. Non-asphalt-based tackifier intended for use in anchoring mulch.

26 2.8 MULCH NET

27 A. Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq yd minimum, with 50 to 65 percent open area. Include
28 manufacturer's recommended biodegradable staples, 6 in. long.

- 1 **2.9** HYDROMULCH
- 2 A. Mixture of fiber mulch and non-asphalt-based tackifying agent.
- 3 PART 3 - EXECUTION
- 4 3.1 FINISH GRADING
- 5 A. Disturbed area shall be graded to be reasonably smooth; fill all washes and gullies to conform to required lines and
6 grades.
- 7 3.2 TOPSOIL PLACEMENT
- 8 A. After completion of finish grading, place minimum of 4 in. of topsoil over areas indicated to be seeded.
- 9 B. Smooth grade topsoil to eliminate irregularities. Remove rocks and hard soil clods. Finished topsoil grade shall be
10 0.5 in. below adjoining grade of any surfaced area.
- 11 3.3 SOIL PREPARATION
- 12 A. Eliminate existing perennial weeds by spraying seedbed with herbicide in accordance with manufacturer's
13 instructions. Re-treat after initial application if live vegetation persists. Proceed with seeding after time period
14 specified by herbicide manufacturer.
- 15 3.4 SEEDING
- 16 A. Apply native seed mixture(s) by broadcast or drilled methods to insure uniform distribution, at supplier's
17 recommended rate for the application. Rake seed lightly into top 1/8 in. of soil, roll lightly, and water with fine
18 spray.
- 19 B. For spring seeding, apply oat cover crop at rate of 70 lb per acre. For fall seeding, apply winter wheat cover crop at
20 rate of 25 lb per acre.
- 21 3.5 MULCHING
- 22 A. Apply straw mulch uniformly in all seeded areas at rate of 1-1/2 tons per acre to a loose depth of 1 to 2 in. Anchor
23 mulch using non-asphalt-based tackifier or mulch nets installed and stapled according to manufacturer's
24 recommendations.
- 25 B. Mulch shall be applied as soon as possible, but within 3 days after seeding. Suspend mulching operations during
26 periods of excessively high winds.
- 27 3.6 HYDROMULCHING
- 28 A. At Contractor's discretion, mulch may be applied by hydromulch method at a minimum rate of 1,700 lb per acre.
- 29 B. Mix components in water using equipment specifically designed for hydromulch application and in accordance with
30 manufacturer's recommendations. Include nonasphaltic tackifying agent in mixture.

- 1 3.7 POST SEEDING MAINTENANCE
- 2 A. Maintain seeded areas for 1-year following planting.
- 3 B. Watering: Lightly water Spring seeding for the first 8 weeks after seeding. Water 15-30 minutes every other day in
4 the early morning. After 8 weeks, water deeply once per week, when there has been no natural rainfall for more
5 than three days. Do not water Fall seeding.
- 6 C. Year One Maintenance: Mow seeded areas to a height of 6-8 in. three times during the first growing season and /or
7 when weeds reach a height of 12-16 in., mow entire planting back to 6-8 in. Mow prior to weeds seed set. Do not
8 pull weeds in the first year. At the end of the fall of the first growing season, leave any standing vegetation and
9 stubble to insulate seedlings and reduce winter frost heaving.

10 3.8 ESTABLISHMENT AND REPLACEMENT

- 11 A. Seeded areas which fail to become established during the 1-year maintenance period shall be reseeded,
12 maintained, and protected to ensure healthy growth at Contractor's expense. Because native seed mixtures are
13 difficult to assess the first year of growth, satisfactory establishment of the cover crop and general erosion control
14 by vegetation shall constitute establishment. Cover crop or desirable seed establishment by June 1 of the following
15 growing season shall be a minimum of 2-1/2 in. high, with no bare spots larger than 6 in. square and total bare
16 spots not exceeding 2 percent of total seeded area.

17 END OF SECTION

1 SECTION 329300 – PLANTS

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section includes:

- 8 1. Furnishing trees, shrubs, and perennials.
9 2. Preparation of planting beds including excavation, backfilling, and disposal of surplus and unsuitable
10 excavated material.
11 3. Planting of trees, shrubs, and perennials, including fertilizing, mulching, and trimming.
12 4. Maintenance of plants until Substantial Completion.
13 5. Gravel surfacing and edging

- 14 B. Related Requirements:

- 15 1. Section 310510 Site Preparation.
16 2. Section 315639 Temporary Tree and Plant Protection.
17 3. Section 329200 Turf and Grasses.
18 4. Section 329236 Native Species Seeding.

19 1.3 SUBMITTALS

- 20 A. Maintenance Instructions: Prior to Substantial Completion, submit two copies of typewritten instructions
21 recommending procedures for maintenance of exterior plants during first year after completion of work.

- 22 B. Make submittals in accordance with contract documents.

23 1.4 INSPECTION

- 24 A. Comply with local, state, and federal laws pertaining to inspection, sale, and shipment of plant materials.

- 25 B. E/A may inspect trees and shrubs either at place of growth or at site before planting for compliance with
26 requirements of name, variety, size, and quality. E/A retains right to further inspect trees and shrubs for size and
27 condition of balls and root systems, insects, injuries, and latent defects, and to reject damaged or defective material
28 at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

29 1.5 DELIVERY, STORAGE, AND HANDLING

- 30 A. Provide freshly dug trees and shrubs. Do not use trees or shrubs which have been in cold storage or heeled-in. Do
31 not prune prior to delivery, except as approved by E/A. Provide adequate protection of root systems and balls from
32 drying winds and sun. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches,

1 or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock
2 during delivery.

3 B. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is
4 delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical
5 damage, and keep roots moist as follows:

6 C. Heal-in bare root stock. Soak roots in water for 2 hours if dried out.

7 D. Set balled stock on ground and cover ball with soil, peat moss, or other acceptable material.

8 E. Do not remove container grown stock from containers until planting time.

9 F. Plants with roots exposed to the sun, or otherwise unprotected during transit, unloading, or storage shall be
10 rejected.

11 1.6 SITE CONDITIONS

12 A. Plant trees, shrubs, and perennials during normal seasons.

13 B. Plant frost-tender plants only after danger of frost is past or sufficiently before frost season to allow for
14 establishment before first frost. Do not plant in frozen ground.

15 C. Plant after final grades are established. If planting occurs after lawn work, protect lawn areas and promptly repair
16 damage to lawns resulting from planting operations.

17 1.7 WARRANTY

18 A. Trees, shrubs, and perennials shall be warranted for one year from day of acceptance. All plants not in vigorous
19 growing condition after one year shall be replaced in first succeeding planting season.

20 PART 2 - PRODUCTS

21 2.1 PLANT MATERIAL, GENERAL

22 A. Provide plants grown in a recognized nursery in accordance with good horticultural practice, with normal, well-
23 developed branch system and healthy root systems developed by transplanting or root pruning. Provide only
24 healthy, vigorous stock grown for at least 2 years under climatic conditions similar to conditions in locality and free
25 of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, or disfigurement.

26 B. Provide plants true to name and variety established by American Joint Committee on Horticultural Nomenclature,
27 "Standardized Plant Names." Comply with recommendations and requirements of ANSI Z60.1 "American Standard
28 for Nursery Stock."

29 C. Provide plants of sizes and species designated and in accordance with dimensional relationship requirements of
30 ANSI Z60.1 for kind and type. Plants of larger size than specified may be used if size of roots and balls are increased
31 proportionately.

32 D. Measure trees and shrubs with branches and trunks or canes in their normal position. Do not prune to obtain
33 required sizes. Take caliper measurements 6 in. above ground for trees up to 4-in. caliper size, and 12 in. above
34 ground for larger sizes. Measure main body of tree or shrub for height and spread dimensions; do not measure
35 from branch or root tip-to-tip.

- 1 E. Label each tree and shrub with a securely attached waterproof tag bearing legible designation of botanical and
2 common name.
- 3 2.2 DECIDUOUS TREES
- 4 A. Provide trees of height and caliper designated.
- 5 B. Shade trees shall be single stem trees with straight trunk and intact leader, free of branches to a point about 60% of
6 their height, as recommended by ANSI Z60.1 for size and kind of trees required.
- 7 C. Where small trees of upright or spreading type are required, provide trees with single stem, branched or pruned
8 naturally according to species and type, and with relationship of caliper and branching recommended by ANSI
9 Z60.1, unless otherwise shown. Where shown as "bush form," provide trees with branching starting close to
10 ground in manner of a shrub. Where shown as "multi-stem", provide trees with 3 or more main stems starting from
11 ground.
- 12 D. Container grown deciduous trees may be substituted for balled and burlapped trees, subject to specified limitations
13 for container stock.
- 14 2.3 DECIDUOUS SHRUBS
- 15 A. Dimensions designated indicate required height or container size.
- 16 B. Provide deciduous shrubs with not less than the minimum number of canes required by ANSI Z60.1 for type shown
17 and height of shrub required. Except as otherwise shown, provide bare root deciduous shrubs.
- 18 C. Where shown as "clump," provide deciduous shrubs with at least twice the number of canes required for standard
19 shrubs.
- 20 D. Container grown deciduous shrubs may be substituted for balled and burlapped shrubs, subject to specified
21 limitations for container grown stock.
- 22 2.4 REQUIREMENTS FOR B & B STOCK
- 23 A. Where shown or specified to be balled and burlapped, provide trees and shrubs dug with firm, natural ball of earth
24 in which they are grown.
- 25 B. Provide ball size of not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub
26 required. Increase ball size or modify ratio of depth to diameter as required to encompass fibrous and feeding root
27 system necessary for full recovery of trees or shrubs.
- 28 C. Wrap and tie earth ball as recommended by ANSI Z60.1 for size of balls required. Drum-lace balls with a diameter
29 of 30 in. or greater.
- 30 2.5 REQUIREMENTS FOR CONTAINER GROWN STOCK
- 31 A. Where specified as acceptable, provide healthy, vigorous, well-rooted trees or shrubs established in container in
32 which they are sold. Provide balled and burlapped stock, when required trees or shrubs exceed maximum size
33 recommended by ANSI Z60.1 for container grown stock.
- 34 B. Established container stock is defined as a tree or shrub transplanted into a container and grown in container for a
35 length of time sufficient to develop new fibrous roots so that root mass will retain its shape and hold together when
36 removed from container.

1 C. Use rigid containers which will hold ball shape and protect root mass during shipping. Provide trees and shrubs
2 established in containers of not less than minimum sizes recommended by ANSI Z60.1 for kind, type, and size of
3 trees and shrubs required.

4 2.6 2.06 REQUIREMENTS FOR BARE ROOT STOCK

5 A. Where specified to be bare root, provide trees and shrubs with a heavy fibrous root system developed by
6 transplanting or root pruning and with not less than minimum root spread recommended by ANSI Z60.1 for kind
7 and size of trees and shrubs required.

8 2.7 PERENNIALS

9 A. Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems
10 reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the
11 container. Provide only plants that are acclimated to outdoor conditions before delivery.

12 2.8 TOPSOIL

13 A. Loam, sandy loam, silt loam, silty clay loam, or clay loam humus-bearing surface soil; 100% passing the 1 in. sieve
14 and at least 90% passing the No. 10 sieve; pH range of 6.0 to 7.0; minimum organic material content of 3 percent;
15 reasonably free of subsoil, clay lumps, brush, and weeds; and free of extraneous matter harmful to plant growth.

16 B. Obtain topsoil from naturally well-drained local sources; do not obtain from bogs or marshes. Topsoil salvaged
17 from within work area may be reused only if it meets the above requirements.

18 2.9 PLANTING SOIL

19 A. Planting Soil Mix: Existing, native surface topsoil formed under natural conditions with the duff layer retained
20 during excavation process. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of
21 roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.

22 1. Supplement with import topsoil when quantities are insufficient.
23 2. Mix existing, native surface topsoil with the following soil amendments and fertilizers in the following
24 quantities to produce planting soil:

- 25 a. Ratio of Loose Compost to Topsoil by Volume: 1:3.
- 26 b. Lime per soil analyst recommendations.
- 27 c. Aluminum Sulfate per soil analyst recommendations.
- 28 d. Weight of Agricultural Gypsum per soil analyst recommendations.
- 29 e. Volume of Sand per soil analyst recommendations.
- 30 f. Weight of Commercial Fertilizer per soil analyst recommendations.
- 31 g. Weight of Slow-Release Fertilizer per soil analyst recommendations.
- 32

33 2.10 FERTILIZER

34 A. Commercial fertilizer for additional plant application shall be standard 10-6-4, nitrogen 10%, phosphoric acid 6%,
35 potash 4%, and shall contain minor trace elements. Formula shall be in conformity with applicable state fertilizer
36 laws.

- 1 2.11 PRE-EMERGENT HERBICIDE
- 2 A. Granular or liquid pre-emergent herbicide formulated with the active ingredient of Trifluralin or Oryzailil under the
3 trade names of Preen, Treflan, Surflan, or approved equal.
- 4 2.12 2.12 VEGETATION BARRIER
- 5 A. Non-woven polypropylene or polyester weed control fabric, 3 oz per sq yd minimum.
- 6 2.13 EDGING
- 7 A. Commercial grade, 3/16" x 4" aluminum landscape edging in minimum 16 ft. lengths with interlocking stakes; use
8 Permaloc CleanLine (www.Permaloc.com) or equivalent.
- 9 2.14 BARK MULCH
- 10 A. Bark mulch, uniform in character, double ground and free of non-degradable materials, sized between 1-1/2 to 2-
11 1/2 in. Cedar, redwood, or cypress mulch is acceptable. Local products, colored or dyed, are also acceptable.
- 12 2.15 ROCK MULCH
- 13 A. River run gravel, 3/4 to 1-1/2 in. size.
- 14 2.16 SLOW RELEASE WATERING DEVICES
- 15 A. Standard product manufactured for drip irrigation of plants and emptying its contents over an extended time
16 period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
- 17 2.17 WATER
- 18 A. Water for execution of all work, including maintenance under this contract, shall be furnished by Contractor. Water
19 shall be suitable for irrigation and free from ingredients harmful to plant life.
- 20 PART 3 - EXECUTION
- 21 3.1 INSTALLATION OF PLANT MATERIALS
- 22 A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and
23 secure E/A's acceptance before start of planting work. Make minor adjustments as may be requested by E/A.
- 24 3.2 EXCAVATION
- 25 A. Excavate circular planting pits with sides sloping inward at a 45 deg. angle. Excavations with vertical sides are not
26 acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in
27 drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to
28 prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

- 1 1. Excavate approximately three times as wide as ball diameter for balled and burlapped and container-grown
2 stock.
- 3 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root
4 ball.
- 5 3. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly
6 tamp the added soil to prevent settling.
- 7 4. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate
8 subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
- 9 5. Maintain supervision of excavations during working hours.
- 10 6. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

11 B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil nor use as backfill.

12 3.3 SETTING AND BACKFILLING

13 A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible,
14 remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil
15 removal to expose the root flare, verify that root ball still meets size requirements.

16 B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

17 C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 in. above adjacent
18 finish grades.

- 19 1. Use planting soil for backfill.
- 20 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and
21 wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove
22 pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during
23 planting operation.
- 24 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting
25 pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering
26 until no more water is absorbed.
- 27 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts
28 recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 in. from
29 root tips; do not place tablets in bottom of the hole.
- 30 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

31 D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 in. above adjacent finish
32 grades.

- 33 1. Use planting soil for backfill.
- 34 2. Carefully remove root ball from container without damaging root ball or plant.
- 35 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting
36 pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering
37 until no more water is absorbed.
- 38 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts
39 recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 in. from
40 root tips; do not place tablets in bottom of the hole.
- 41 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

42 E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the
43 slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover
44 the downhill side of the root ball.

- 1 3.4 MULCH BEDS
- 2 A. Construct mulch beds where indicated on Drawings, minimum 3 in. thick unless otherwise shown. Dish top of
3 backfill to allow for mulching. Top of mulch shall be level with adjacent finished grades.
- 4 1. Apply pre-emergent herbicide prior to placing bark mulch using method and rates specified by the product
5 manufacturer. Apply uniformly and under favorable conditions to optimize effectiveness of product.
6 Dispose of spent containers offsite as recommended by manufacturer.
- 7 2. Provide vegetation barrier under all rock mulch, unless otherwise shown.
- 8 3.5 GRAVEL SURFACING
- 9 A. Construct gravel surfacing where shown, with a minimum 4 in. thick rock mulch over vegetation barrier, unless
10 otherwise shown. Install edging as detailed Install edging where indicated on Drawings.
- 11 3.6 SPRAYING
- 12 A. If moved in full-leaf, spray deciduous trees and shrubs with antidessicant at nursery before moving and again 2
13 weeks after planting. Provide an adequate film on trunks, branches, stems, twigs, and foliage.
- 14 3.7 PRUNING
- 15 A. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to
16 retain required heights and spread. Unless otherwise directed by E/A, do not cut tree leaders; remove only injured,
17 dying, or dead branches from trees and shrubs. Prune trees and shrubs to retain natural character and accomplish
18 their use in the landscape design. Required shrub sizes are the size after pruning.
- 19 B. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
- 20 C. Do not apply pruning paint to wounds.
- 21 3.8 INSTALLING SLOW RELEASE WATERING DEVICES
- 22 A. Provide one device for each tree.
- 23 B. Place device on top of mulch at base of tree stem and fill with water according to manufacturer's written
24 instructions.
- 25 C. Leave device in place when tree is accepted by Owner.
- 26 3.9 PERENNIAL PLANTING
- 27 A. Use planting soil for backfill.
- 28 B. Dig holes large enough to allow spreading of roots.
- 29 C. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a
30 depth not less than two nodes.
- 31 D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

- 1 E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- 2 F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting
3 shock.
- 4 3.10 MAINTENANCE
- 5 A. Until work is accepted by Owner, make periodic checks to make certain that materials are properly watered,
6 cultivated, and pruned, that all guys and stakes are in proper adjustment, and that conditions are contributing to
7 satisfactory progress of materials.
- 8 3.11 CLEAN UP
- 9 A. Promptly remove soil, manure, peat, or similar material from paved areas; keep area clean at all times. Upon
10 completion of planting, remove excess soil, stones, and debris from site. Ground areas disturbed as a result of
11 planting operations shall be restored to their original condition or to desired new appearance.
- 12 END OF SECTION

1 SECTION 331130 – WATER SERVICE

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.
- 6 B. City of Madison Standard Specifications for Public Works Construction, latest edition.
- 7 C. American Society for Testing and Materials (ASTM)
- 8 1. B88 Standard Specifications for Seamless Copper Water Tube
 - 9 2. F477 Standard Specifications for Elastomeric Gaskets for Joining Plastic Pipe
 - 10 3. D3139 Standard Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
 - 11 4. D3350 Standard Specifications for Polyethylene Plastic Pipe and Fittings Materials American Water Works
12 Association (AWWA)
 - 13 5. C104/ANSI A21.4-95 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
 - 14 6. C105/ANSI A21.5-99 Standard for Polyethylene Encasement for Ductile-Iron Piping for Water and Other
15 Liquids
 - 16 7. C111/ANSI A21.11-00 Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
 - 17 8. C151/ANSI A21.51-02 Standard for Ductile Iron Pipe, Centrifugally Cast for Water or Other Liquids
 - 18 9. C153/ANSI A2L53-00 Standard for Ductile Iron Compact Fittings for Water or Other Liquids
 - 19 10. C502-94 Dry Barel Fire Hydrants
 - 20 11. C504-00 Rubber-Seated Butterfly Valves
 - 21 12. C509-01 Resilient-Seated Gate Valves for Water Supply Service
 - 22 13. C515-01 Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
 - 23 14. C550-01 Protective Epoxy Interior Coatings for Valves and Hydrants
 - 24 15. C800-01 Underground Service Line Valves and Fittings
 - 25 16. C900-97 Polyvinyl Chloride Pressure Pipe, and Fabricated Fittings for Water Distribution (4"-12")
 - 26 17. C905-97 Polyvinyl Chloride Pressure Pipe, and Fabricated Fittings for Water Distribution (14"-48")
 - 27 18. C906-99 Polyethylene Pressure Pipe, and Fabricated Fittings for Water Distribution (4"-63")

28 1.2 SUMMARY

- 29 A. Section Includes:
- 30 1. Provide water service as shown and as specified.
- 31 B. Related Requirements:
- 32 1. Section 312000 Earth Moving.
 - 33 2. Section 312500 Erosion Control.

34 1.3 SUBMITTALS

- 35 A. Product Data: Submit product data for pipe, fittings, joint restraint devices, valves, and hydrants.
- 36 B. Test Reports: Submit reports for bacteriological tests, pressure and leak tests, and electrical continuity test.
37 Include NFPA Material and Test Certificate for installed ductile iron water service.

1 C. Record Drawings: Accurately record locations of service pipe, valves, fittings, and field changes on a set of
2 Drawings. Prior to final application for payment, deliver record drawings to A/E.

3 D. Digital Survey: All utilities shall be digitally surveyed prior to being buried. Digital surveys shall include invert
4 elevations, rim elevations, bend locations, and vertical drop locations. Digital Survey shall meet City of Madison's
5 Digital Survey specifications. Prior to final application for payment, deliver digital survey to A/E.

6 E. Make submittals in accordance with the contract documents.

7 1.4 REGULATORY REQUIREMENTS

8 A. The wetted surface of pipes, pipe fittings, and fixtures (except fire hydrants) in contact with potable water shall
9 have a lead content of less than or equal to 0.25% by weight.

10 B. Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay
11 all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-
12 of-way, street opening permits, utility connection permits, and plumbing permits.

13 1.5 PROVISIONS FOR FUTURE WORK

14 A. Construct watermain system in a manner that will facilitate future extension or connection.

15 PART 2 - PRODUCTS

16 2.1 GENERAL

17 A. All materials shall be new and free of defects.

18 2.2 MATERIALS

19 A. Per Article 702 of the City of Madison Standard Specifications.

20 B. Tracer Wire

- 21 1. Galvanized or stainless steel.
22 2. ¼-inch diameter braided cable.
23 3. 2,000-lb minimum breaking strength.
24 4. Protective PVC coating (to resist corrosion and damage during installation).

25 C. Locator Tape

- 26 1. Detectable metallic locator tape, specifically manufactured for marking utilities.
27 2. Tape shall be a minimum 6" wide and designed to be detectable at a depth of 18".
28 3. Tape shall be marked "WATER" and blue colored.

29 D. Test Stations

- 30 1. Blue Rhino Triview flex test stations, or approved equal, with black caps at each surface location.

1 PART 3 - EXECUTION

2 3.1 INSTALLATION

3 A. Per Article 703 of the City of Madison Standard Specifications.

4 B. Locating Requirements – A means to locater buried exterior nonmetallic watermains and water services must be
5 provided with tracer wire or other methods to locate, in accordance with the provisions of Wisconsin State statute
6 182.0715(2R).

7 C. Install Detectable underground marking tape directly above all PVC, and other nonconductive underground utilities
8 at a depth of 18” below finish grade, unless otherwise indicated.

9 3.2 CONNECTING MAINS

10 A. Per Article 703.7 of the City of Madison Standard Specifications.

11 3.3 TESTING

12 A. Per Article 703.13, and 703.14, and 703.15 of the City of Madison Standard Specifications.

13 3.4 ELECTRICAL CONTINUITY

14 A. Per Article 703.15 of the City of Madison Standard Specifications.

15 3.5 FINAL INSPECTION

16 A. Per Article 703.17 of the City of Madison Standard Specifications.

17 END OF SECTION

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1 SECTION 333130 – SANITARY SERVICE

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

8 1. Provide sanitary sewer service as shown and as specified.

- 9 B. Related Requirements:

10 1. Section 312000 Earth Moving.

11 1.3 REFERENCES

- 12 A. Standard Specification for Sewer and Water Construction in Wisconsin.

- 13 B. City of Madison Standard Specifications for Public Works Construction, Current Edition.

14 1.4 SUBMITTALS

- 15 A. Shop Drawings: Submit shop drawings for manholes.

- 16 B. Product Data: Submit product data for pipe, fittings, couplings, tracer wire, and tracer wire access boxes.

- 17 C. Test Reports: Submit report for leakage testing.

- 18 D. Record Drawings: Accurately record locations of service pipe and field changes on a set of Drawings. Prior to final
19 application for payment, deliver record drawings to A/E.

- 20 E. Digital Survey: All utilities shall be digitally surveyed prior to being buried. Digital surveys shall include invert
21 elevations, rim elevations, bend locations, and vertical drop locations. Digital Survey shall meet City of Madison's
22 Digital Survey specifications. Prior to final application for payment, deliver digital survey to A/E.

- 23 F. Make submittals in accordance with contract documents.

24 1.5 PROJECT CONDITIONS

- 25 A. Consult the Owner's site construction plans for known underground and surface utility lines.

- 26 B. The Contractor shall verify existing utility locations. All utility information is based on record drawings, field
27 location of surface features, and survey data when available.

- 1 C. Protect existing trees, plants, lawns and other features designated to remain as part of the landscaping work.
- 2 D. Promptly repair damage to adjacent facilities caused by earthwork operations. Cost of repair at Contractor's
- 3 expense.
- 4 E. Dewatering shall be provided as required and routed through an appropriately sized settling tank and/or sediment
- 5 bag.
- 6 F. Promptly notify the Engineer of unexpected subsurface conditions.

7 1.6 REGULATORY REQUIREMENTS

- 8 A. Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay
- 9 all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-
- 10 of-way, street opening permits, utility connection permits, and plumbing permits.

11 PART 2 - PRODUCTS

12 2.1 GENERAL

- 13 A. All materials shall be new and free of defects.

14 2.2 MATERIALS

- 15 A. Per Article 503 and 507 of the City of Madison Standard Specifications.
- 16 B. Tracer Wire
- 17 1. Galvanized or stainless steel.
- 18 2. ¼-inch diameter braided cable.
- 19 3. 2,000-lb minimum breaking strength.
- 20 4. Protective PVC coating (to resist corrosion and damage during installation).
- 21 C. Locator Tape
- 22 1. Detectable metallic locator tape, specifically manufactured for marking utilities.
- 23 2. Tape shall be a minimum 6" wide and designed to be detectable at a depth of 18".
- 24 3. Tape shall be marked "SEWER" and green colored.
- 25 D. Test Stations
- 26 1. Blue Rhino Triview flex test stations, or approved equal, with black caps at each surface location.

27 PART 3 - EXECUTION

28 3.1 INSTALLATION

- 29 A. Per Article 501, 502, 503, and 507 of the City of Madison Standard Specifications.
- 30 B. Locating Requirements – A means to locater buried exterior nonmetallic sewer main and sewer services must be
- 31 provided with tracer wire or other methods to locate, in accordance with the provisions of Wisconsin State statute
- 32 182.0715(2R).

1 C. Install Detectable underground marking tape directly above all PVC, and other nonconductive underground utilities
2 at a depth of 18" below finish grade, unless otherwise indicated. Bring the tape to the surface at various locations in
3 order to provide connection points for location underground utilities. Install test stations at each surface location.

4 3.2 TESTING

5 A. Per Article 501.3 of the City of Madison Standard Specifications.

6 3.3 FINAL INSPECTION

7 A. Per Article 501.3 of the City of Madison Standard Specifications.

8 3.4 DISPOSAL OF WASTE MATERIALS

9 A. Remove from site and legally dispose of trash and debris.

10 3.5 CLEANING

11 A. Upon completion of earthwork operations, clean areas within contract limits, remove tools and equipment. Provide
12 site clear, clean, free of debris and soot.

13 END OF SECTION

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1 SECTION 334120 – SITE STORM SYSTEM

2 PART 1 - GENERAL

3 1.1 RELATED DOCUMENTS

- 4 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01
5 Specification Sections, apply to this Section.

6 1.2 SUMMARY

- 7 A. Section Includes:

8 1. Provide site storm sewer system as shown and as specified.

- 9 B. Related Requirements:

10 1. Section 312000 Earth Moving

11 2. Section 033000 Cast In-Place Concrete

12 1.3 REFERENCES

- 13 A. Applicable provisions of Division 1 shall govern all work under this section.

14 B. Where these specifications do not cover portions of the work to be undertaken, the Standard Specifications for
15 Sewer and Water Construction in Wisconsin, current edition, shall govern the work.

16 C. City of Madison Standard Specifications for Public Works Construction, Current Edition.

- 17 D. American Society for Testing and Materials (ASTM):

18 1. C76-11 Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

19 2. C443-10 Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets

20 3. C507-11 Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe

21 4. C877-08 Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box
22 Sections

23 1.4 SUBMITTALS

- 24 A. Shop Drawings: Submit shop drawings for drainage structures.

25 B. Product Data: Submit product data for pipe, fittings, and tracer wire.

26 C. Record Drawings: Accurately record locations of storm pipe and field changes on a set of Drawings. Prior to final
27 application for payment, deliver record drawings to A/E.

28 D. Digital Survey: All utilities shall be digitally surveyed prior to being buried. Digital surveys shall include invert
29 elevations, rim elevations, bend locations, and vertical drop locations. Digital Survey shall meet City of Madison's
30 Digital Survey specifications. Prior to final application for payment, deliver digital survey to A/E.

- 1 E. Make submittals in accordance with the contract documents.
- 2 1.5 PROJECT CONDITIONS
- 3 A. Consult the Owner's site construction plans for known underground and surface utility lines.
- 4 B. The Contractor shall verify existing utility locations. All utility information is based on record drawings, field
5 location of surface features, and survey data when available.
- 6 C. Protect existing trees, plants, lawns and other features designated to remain as part of the landscaping work.
- 7 D. Promptly repair damage to adjacent facilities caused by earthwork operations. Cost of repair at Contractor's
8 expense.
- 9 E. Dewatering shall be provided as required and routed through an appropriately sized settling tank and/or sediment
10 bag.
- 11 F. Promptly notify the Engineer of unexpected subsurface conditions.
- 12 1.6 REGULATORY REQUIREMENTS
- 13 A. Contractor shall be solely responsible for obtaining all permits necessary to complete the work. Contractor shall pay
14 all fees associated with obtaining permits. These include, but are not limited to permits for work within public right-
15 of-way, street opening permits, utility connection permits, and plumbing permits.
- 16 PART 2 - PRODUCTS
- 17 2.1 GENERAL
- 18 A. All materials shall be new and free of defects.
- 19 2.2 MATERIALS
- 20 A. Per Article 503 and 507 of the City of Madison Standard Specifications.
- 21 B. Tracer Wire
22 1. Galvanized or stainless steel.
23 2. ¼-inch diameter braided cable.
24 3. 2,000-lb minimum breaking strength.
25 4. Protective PVC coating (to resist corrosion and damage during installation).
- 26 C. Locator Tape
27 1. Detectable metallic locator tape, specifically manufactured for marking utilities.
28 2. Tape shall be a minimum 6" wide and designed to be detectable at a depth of 18".
29 3. Tape shall be marked "SEWER" and green colored.
- 30 D. Test Stations
31 1. Blue Rhino Triview flex test stations, or approved equal, with black caps at each surface location.

1 PART 3 - EXECUTION

2 3.1 INSTALLATION

- 3 A. Per Article 501, 502, 504, 506 and 507 of the City of Madison Standard Specifications.
- 4 B. Locating Requirements – A means to locate buried exterior nonmetallic watermain and water services must be
5 provided with tracer wire or other methods to locate, in accordance with the provisions of Wisconsin State statute
6 182.0715(2R).
- 7 C. Install Detectable underground marking tape directly above all PVC, and other nonconductive underground utilities
8 at a depth of 18” below finish grade, unless otherwise indicated. Bring the tape to the surface at various locations in
9 order to provide connection points for location underground utilities. Install test stations at each surface location.

10 3.2 TESTING

- 11 A. Per Article 501.3 of the City of Madison Standard Specifications.

12 3.3 FINAL INSPECTION

- 13 A. Per Article 501.3 of the City of Madison Standard Specifications.

14 3.4 DISPOSAL OF WASTE MATERIALS

- 15 A. Remove from site and legally dispose of trash and debris.

16 3.5 CLEANING

17 Upon completion of earthwork operations, clean areas within contract limits, remove tools and equipment. Provide site clear,
18 clean, free of debris and silt.

19 END OF SECTION

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