

Project Manual

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Bid Documents

November 30, 2018

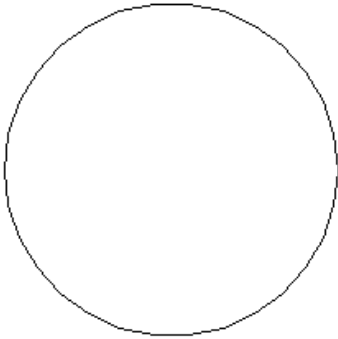
Madison Contract No. 7662
OPN Project No. 17609000



SEALS AND SIGNATURES

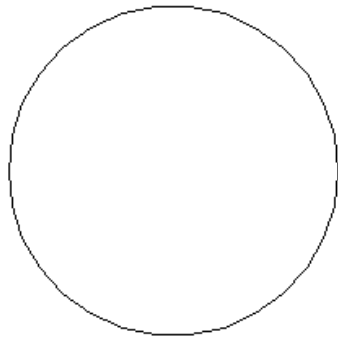
ARCHITECT OF RECORD:

OPN ARCHITECTS

	I hereby certify these plans and specifications were prepared by me or under my direct personal supervision and that I am a duly licensed professional architect under the laws of the state of Wisconsin.		
	Name:	Wesley Reynolds	
	Discipline:	Architect	
	Registration No:	11709-5	Expiration Date: 07/31/2020
	Sheets covered by this seal:	Listed As "Architectural"	

STRUCTURAL ENGINEER:

IMEG CORP.

	I hereby certify this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed professional engineer under the laws of the state of Wisconsin.		
	Name:	Abby A. Pertzborn	
	Discipline:	Structural Engineer	
	Registration No:	E38745-6	Expiration Date: 7/31/2020
	Sheets covered by this seal:	Listed As "Structural"	

MECHANICAL/ PLUMBING ENGINEER: IMEG CORP.

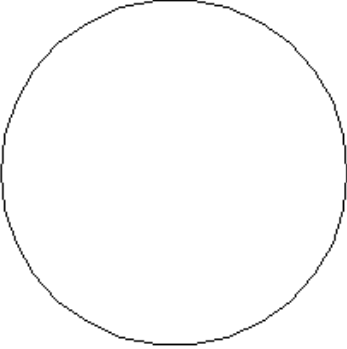
	I hereby certify this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed professional engineer under the laws of the state of Wisconsin.	
	Name:	Paul P. Hansen
	Discipline:	Mechanical Engineer
	Registration No:	E41764-8 Expiration Date: 07/31/2020
	Sheets covered by this seal:	Listed As "Mechanical" / "Plumbing"

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PROCUREMENT AND CONTRACTING REQUIREMENTS

Division 00 -- Procurement and Contracting Requirements

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- 00 43 43 – Wage Rates Form
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- 01 25 13 - Product Substitution Procedures
- 01 26 13 – Request for Information (RFI)
- 01 26 46 – Construction Bulletin (CB)
- 01 26 57 - Change Order Request (COR)
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- 01 29 73 – Schedule of Values
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- 01 31 13 – Project Coordination
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- 01 32 16 – Construction Progress Schedules
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- 01 50 00 – Temporary Facilities and Controls
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- 01 60 00 – Product Requirements
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- 01 73 29 – Cutting and Patching
- 01 74 13 – Progress Cleaning
- 01 74 19 – Construction Waste Management and Disposal
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- 01 78 23 – Operation and Maintenance Data
- 01 78 36 – Warranties
- 01 78 39 – As-Built Drawings
- 01 78 43 – Spare Parts and Extra Materials
- 01 79 00 – Demonstration and Training
- 01 81 13 – Sustainable Design Requirements – LEEDv3
- 01 91 00 – General Commissioning Requirements
- 01 95 00 – Measurement and Verification

Division 02 -- Existing Conditions

- 02 41 00 – Demolition

Division 03 -- Concrete - NOT USED, Included on Structural Drawings

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4	Division 05 -- Metals - NOT USED
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6	Division 06 -- Wood, Plastics, and Composites
7	06 10 00 - Rough Carpentry
8	06 15 00 – Wood Deck Tiles
9	06 20 00 – Finish Carpentry
10	06 41 00 - Architectural Wood Casework
11	06 42 00 – Linear Wood Paneling
12	06 60 10 – Polymer Resin Fabrications
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14	Division 07 -- Thermal and Moisture Protection
15	07 21 19 - Foamed-In-Place Insulation
16	07 84 00 - Firestopping
17	07 92 00 - Joint Sealants
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19	Division 08 -- Openings
20	08 11 13 - Hollow Metal Doors and Frames
21	08 14 16 – Flush Wood Doors
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29	09 30 00 - Tiling
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31	09 62 29 - Cork Flooring
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44	10 22 29 - Full Height Glazed Partition System
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54	12 24 00 - Window Shades
55	12 36 00 – Countertops
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4	Division 21 -- Fire Suppression
5	21 05 00 - Basic Fire Suppression Requirements
6	21 05 03 - Through Penetration Firestopping
7	21 05 29 - Fire Suppression Supports and Anchors
8	21 05 53 - Fire Suppression Identification
9	21 13 00 - Fire Protection Systems
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11	Division 22 -- Plumbing
12	22 05 00 - Basic Plumbing Requirements
13	22 05 03 - Through Penetration Firestopping
14	22 05 29 - Plumbing Supports and Anchors
15	22 05 53 - Plumbing Identification
16	22 07 19 - Plumbing Piping Insulation
17	22 09 00 - Instrumentation
18	22 10 00 - Plumbing Piping
19	22 10 30 - Plumbing Specialties
20	22 30 00 - Plumbing Equipment
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24	23 05 00 - Basic HVAC Requirements
25	23 05 03 - Through Penetration Firestopping
26	23 05 13 - Motors
27	23 05 15 - Variable Frequency Drives
28	23 05 29 - HVAC Supports and Anchors
29	23 05 48 - HVAC Vibration Isolation
30	23 05 53 - HVAC Identification
31	23 05 93 - Testing, Adjusting and Balancing
32	23 07 13 - Ductwork Insulation
33	23 07 16 - HVAC Equipment Insulation
34	23 07 19 - HVAC Piping Insulation
35	23 09 00 - Controls
36	23 09 13 - Instrumentation
37	23 21 00 - Hydronic Piping
38	23 21 23 - HVAC Pumps
39	23 23 00 - Refrigeration Piping and Specialties
40	23 25 00 - Chemical (Water) Treatment
41	23 31 00 - Ductwork
42	23 33 00 - Ductwork Accessories
43	23 36 00 - Air Terminal Units
44	23 37 00 - Air Inlets and Outlets
45	23 40 00 - Air Cleaning
46	23 57 33 - Geothermal Heat Exchangers
47	23 72 00 - Energy Recovery Devices
48	23 73 13 - Indoor Modular Air Handling Units
49	23 81 45 - Variable Refrigerant Flow Heat Pumps
50	23 81 46 - Packaged Water Source Heat Pumps
51	23 82 00 - Terminal Heat Transfer Units
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54	26 05 00 - Basic Electrical Requirements
55	26 05 03 - Through Penetration Firestopping
56	26 05 13 - Wire And Cable
57	26 05 26 - Grounding and Bonding

1	26 05 27 - Supporting Devices
2	26 05 33 - Conduit and Boxes
3	26 05 36 - Cable Trays
4	26 05 53 - Electrical Identification
5	26 05 73 - Power System Study
6	26 09 33 - Lighting Control Systems
7	26 24 16 - Panelboards
8	26 24 19 - Motor Control
9	26 27 26 - Wiring Devices
10	26 28 13 - Fuses
11	26 28 16 - Disconnect Switches
12	26 28 21 - Contactors
13	26 43 00 - Surge Protection Devices
14	26 51 00 - Lighting
15	26 52 15 - Emergency Power Supply
16	
17	Division 27 -- Communications
18	27 05 00 - Basic Communications Systems Requirements
19	27 05 26 - Communications Bonding
20	27 05 28 - Interior Communication Pathways
21	27 05 53 - Identification and Administration
22	27 11 00 - Communication Equipment Rooms
23	27 13 00 - Backbone Cabling Requirements
24	27 15 00 - Horizontal Cabling Requirements
25	27 17 10 - Testing
26	27 17 20 - Support and Warranty
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28	27 41 23 - Audio-Visual Accessories
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31	28 05 00 - Basic Safety and Security Systems Requirements
32	28 13 00 - Electronic Access Control
33	28 20 00 - Electronic Surveillance
34	28 31 00 - Fire Alarm and Detection Systems
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36	Division 31 -- Earthwork - NOT USED
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39	32 18 16.13 - Playground Protective Surfacing
40	32 31 19 - Decorative Metal Fences and Gates
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**SECTION 00 31 46
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6 1.2. REFERENCES 1
7 1.3. GENERAL CONTRACTORS REQUIREMENTS 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
9 PART 3 – EXECUTION – THIS SECTION NOT USED 1

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. Exception: fees required for all
45 permits issued by City of Madison agencies will be paid by internal payment by the City of Madison.
46 3. Scheduling all required inspections that may be conditions of any required permits.
47 B. The GC shall provide high quality scanned images of all required permits and inspections and upload them to the
48 Contract Documents-Regulatory Documents Library on the Project Management Web Site.
49

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

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52 **PART 3 – EXECUTION – THIS SECTION NOT USED**

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56 **END OF SECTION**
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**SECTION 00 43 25
SUBSTITUTION REQUEST FORM (DURING BIDDING)**

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5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATIONS 1
7 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
8 PART 3 - EXECUTION 1
9 3.1. REQUESTING A SUBSTITUTION DURING BIDDING 1
10 3.2. SUBMISSION REVIEW 2
11 3.3. SUBSTITUTION APPROVAL 2
12 3.4. SUBSTITUTION REQUEST FORM 3
13

14 **PART 1 – GENERAL**

15
16 **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 procedures in this specification shall apply to all proposals by Contractors, Suppliers, Vendors, and
26 Manufacturers when the conditions in item 1.1.B. above have been met during the bidding phase.
27

28 **1.2. RELATED SPECIFICATIONS**

- 29 A. 01 25 13 Product Substitution Procedures
30

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

32
33 **PART 3 - EXECUTION**

34
35 **3.1. REQUESTING A SUBSTITUTION DURING BIDDING**

- 36 A. In the event that a substitution is requested during the bidding phase the Contractor, Supplier, Vendor, or
37 Manufacturer shall do all of the following:
38 1. Submit a Substitution Request Form for each different product. Use a printed/scanned copy of the form
39 at the end of this specification as a cover sheet.
40 2. Support your request with complete data, drawings, specifications, performance data and samples as
41 appropriate. A complete submission shall include the following:
42 a. Substitution Request Form as a cover sheet
43 b. Comparison of qualities of the proposed substitutions with that specified.
44 c. Changes required in other elements of the Work because of the substitution.
45 d. Effect on the construction schedule.
46 e. Cost data comparing the proposed substitution with the Product specified.
47 f. Any required license fees or royalties.
48 g. Availability of maintenance service and source of replacement materials.
49 3. Submit the Substitution Request Form and all required supporting documentation to the City Project
50 Manager and Project Architect.
51 a. Submissions to be done as complete PDF files for each product, appropriately titled
52 b. Email submissions to the Project Architect and City Project Manager at the email addresses
53 provided on the last page of Section D of the contract documents.
54 i. The subject line shall include the contract number and “Request for Substitution”.
55 Example: Contract 1234 – Request for Substitution
56 4. Submissions must be received by the substitution request deadline specified in Section A of the Contract
57 Documents.
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3.2. SUBMISSION REVIEW

- A. The Project Architect, City Project Manager, members of the design team, and the Owners staff shall review all submissions for substitutions during the bidding phase.

3.3. SUBSTITUTION APPROVAL

- A. All requests for substitutions that have been approved shall be published by Addenda to the bid documents.

NOTE SEE NEXT PAGE FOR SAMPLE SUBSTITUTION REQUEST FORM.

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3.4. SUBSTITUTION REQUEST FORM

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

	<h1>Substitution Request</h1>		
Today's Date:	<input type="text"/>		
Project Title:	<input type="text"/>		
Project Number:	<input type="text"/>	Contract Number:	<input type="text"/>
<p><i>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</i></p> <ol style="list-style-type: none"><i>The General Contractor affirms that this request is in compliance with the requirements described in Specification 01 25 13 Product Substitution Procedures.</i><i>The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.</i><i>The proposed substitution does not affect dimensions shown on the drawings.</i><i>The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.</i><i>Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)</i><i>The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not to limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.</i>			
<p style="text-align: center;"><u>GC Substitution Request:</u></p>			
General Title:	<input type="text"/>		
Related Specification:	<input type="text"/> <input type="text"/> <input type="text"/>		
Reason for Substitution:	<input type="text"/>		
Proposed Substitution: (include Name, Model, etc.)	<input type="text"/>		
Submitted By:	<input type="text"/>	Phone:	<input type="text"/>
Company:	<input type="text"/>	Email:	<input type="text"/>

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END OF SECTION

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**SECTION 00 43 43
WAGE RATES FORM**

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PART 1 – GENERAL 1
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1.2. RELATED SPECIFICATIONS 1
PART 2 – PRODUCTS – NOT USED 1
PART 3 - EXECUTION 1
3.1. GENERAL REQUIREMENTS..... 1
3.2. GENERAL CONTRACTORS RESPONSIBILITIES 1

PART 1 – GENERAL

1.1. SUMMARY

- A. The Reimbursable Hourly Worksheet is a contractor provided document that indicates the basic rate of pay, fringe benefits, and each companies cost of required insurance for all Trades and Classifications that will be performing productive labor during the execution of this contract.
 - 1. Rates shall be similar to recognized rates published by the Bureau of Labor Statistics, Associated General Contractors (AGC), Associated Builders and Contractors (ABC), appropriate union contracts, and other similar organizations or documents.
- B. The Reimbursable Labor Rate Worksheet shall provide the basis for labor rates being used on Change Order Request forms.

1.2. RELATED SPECIFICATIONS

- A. Section 01 26 57 Change Order Request
- B. Section 01 29 76 Progress Payment Procedures
- C. Section 01 31 23 Project Management Web Site (SharePoint)
- D. Section 01 32 19 Submittals Schedule

PART 2 – PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1. GENERAL REQUIREMENTS

- A. Prior to the Pre-Construction Meeting the City Project Manager (CPM) or the City Construction Manager (CCM) shall provide the GC a copy of the *Reimbursable Labor Rate Worksheet.xls*.
 - 1. See the last page of this specification for an example of the worksheet.
- B. The GC shall provide all subcontractors that will be performing productive labor during the execution of this contract with additional copies of the worksheet as needed.
- C. All contractors shall be required to fill out and submit completed worksheets for all Trades and Classifications of labor that will be performing productive labor during the execution of this contract.

3.2. GENERAL CONTRACTORS RESPONSIBILITIES

- A. The GC shall consolidate all Trades and Classifications into one master Excel Workbook of all trades.
- B. The GC shall provide the combined workbook as required by Section 1.6 of Specification 01 32 19 Submittals Schedule for review and approval by the Owners Representatives.
 - 1. Submittal shall be an Exported PDF of the completed Excel Workbook.
 - a. As an Exported PDF the individual worksheets will be bookmarked and the document will be word searchable for easy reference.
- C. The GC shall only use the rates posted in the approved submittal throughout the execution of this contract.

1
 2

Reimbursable Hourly Rate Worksheet

(see bottom of page for instructions)

Project Name: _____
 Project Location: _____
 Project Number: _____
 Contractor: _____
 Rates are based on the following documentation: _____

Enter TRADE Here:

Carpenter

<u>Classification:</u>		<u>Foreman</u>	<u>Journeyman</u>	<u>Laborer</u>	<u>Apprt 1</u>	<u>Other</u>	<u>Other</u>	<u>Other</u>
Base Rate (BR)		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Vacation		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Health Insurance		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Pension		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Apprenticeship		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<i>Sub-total</i>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
BR Sub-total		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Work. Comp	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Gen Liability	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
WI Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Fed Unemploy	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
FICA	% of BR	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
<i>Sub-total</i>		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
TOTAL COST		\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00

Enter YOUR percentage of base rate in the column below.

0	- Work. Comp
0	- Gen Liability
0	- WI Unemploy
0.6	- Fed Unemploy
7.65	- FICA

Form Instructions:

1. Provide a work sheet for ALL Trade Classifications that will be performing on site productive labor during the execution of this project.
2. Responsible contractor to complete only boxes that are shaded, all non-shaded boxes are formula driven.
3. Contractor shall provide the name of the source used for these rates. (union contract, Bureau of Labor and Statistics, AGC, ABC, etc.) and be prepared to provide copies if so requested.

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END OF SECTION

**SECTION 00 62 76.13
SALES TAX FORM**

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4 PART 1 – GENERAL 1
5 1.1. SUMMARY 1
6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.2. TAX EXEMPT FORM 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 1
9 PART 3 – EXECUTION – THIS SECTION NOT USED 1

10
11 **PART 1 – GENERAL**

12
13 **1.1. SUMMARY**

- 14 A. The City of Madison is a qualifying tax exempt entity in the State of Wisconsin.
15 B. The Contractor shall refer to *Section 102.9 – Bidders Understanding of the City of Madison Standard*
16 *Specifications for Public Works Construction* for more information on Tax Exempt Status.
17 C. This project constructs or remodels facilities owned by the City of Madison in Madison, Wisconsin.
18

19 **1.2. RELATED SPECIFICATION SECTIONS**

- 20 A. Parts of this specification will reference articles within “The City of Madison Standard Specifications for Public
21 Works Construction”.
22 1. Use the following link to access the Standard Specifications web page:
23 <http://www.cityofmadison.com/business/pw/specs.cfm>
24 a. Click on the “Part” chapter identified in the specification text. For example if the specification
25 says “Refer to City of Madison Standard Specification 210.2” click the link for Part II, the Part II
26 PDF will open.
27 b. Scroll through the index of Part II for specification 210.2 and click the text link which will take you
28 to the referenced text.
29

30 **1.3. TAX EXEMPT FORM**

- 31 A. The Contractor can access Wisconsin Sales and Use Tax Exemption Certificates (form S-211, Wisconsin
32 Department of Revenue) from the City of Madison Finance website.
33 1. City of Madison tax exempt information and signature by Purchasing Supervisor is already completed.
34 2. Website: <http://www.cityofmadison.com/employeeenet/finance/purchasing>
35 a. Under the title *Purchasing Forms*, scroll down to the form link titled *Sales Tax Exempt Form S-211*.
36

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

38
39 **PART 3 – EXECUTION – THIS SECTION NOT USED**

40
41
42
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44 **END OF SECTION**
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SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

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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

- 37
38
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 1. Contractors and suppliers shall use the screen shot of the form located at the end of this specification to
42 print a hard copy for all pre-bid substitution requests.
43 B. After bidding only the GC shall submit a request and shall use the form located on the Project Management Web
44 Site.
45
46

PART 3 - EXECUTION

3.1. REQUESTING A SUBSTITUTION DURING BIDDING

- 47
48
49 A. In the event that a substitution is requested during the bidding phase the Contractor or Supplier shall meet the
50 substitution request deadline listed in the bidding documents. No substitution request will be considered during
51 the bidding period after the stated substitution request deadline. In general this procedure shall be as follows:
52 1. Submit a Substitution Request Form for each different product
53 2. Support your request with complete data, drawings, specifications, performance data and samples as
54 appropriate. A complete submission shall include the following:
55 i. Substitution Request Form as a cover sheet
56 ii. Comparison of qualities of the proposed substitutions with that specified.
57 iii. Changes required in other elements of the Work because of the substitution.
58

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- iv. Effect on the construction schedule.
 - v. Cost data comparing the proposed substitution with the Product specified.
 - vi. Any required license fees or royalties.
 - vii. Availability of maintenance service and source of replacement materials.
- 3. Submit the Substitution Request Form and all required supporting documentation to the City Project Manager and Project Architect.
 - i. Submissions to be done as complete PDF files for each product, appropriately titled
 - ii. Email submissions to the Project Architect and City Project Manager at the email addresses provided on the last page of Section D of the contract documents.
 - iii. Submissions must be received by the substitution request deadline specified in Section A of the Contract Documents.
 - B. Substitutions submitted and approved during the bidding phase shall be announced by the City of Madison by addenda prior to the bid due date.
 - C. The Owner and Architect may reject any substitution request without providing specific reasons.

3.2. REQUESTING A SUBSTITUTION AFTER AWARD OF CONTRACT

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

3.3. UNAUTHORIZED SUBSTITUTIONS

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

NOTE SEE NEXT PAGE FOR SAMPLE SUBSTITUTION REQUEST FORM.

1

For Pre-bid Substitution Requests all text boxes on this form are required information for a complete request.

	<h1>Substitution Request</h1>
Today's Date:	<input type="text"/>
Project Title:	<input type="text"/>
Project Number:	<input type="text"/>
Contract Number:	<input type="text"/>
<p>By completing and submitting this form for review the General Contractor affirms that all of the following statements are correct:</p> <ol style="list-style-type: none">1 The General Contractor affirms that this request is in compliance with the requirements described in <i>Specification 01 25 13 Product Substitution Procedures</i>.2 The function, appearance, and quality of the proposed substitution are equal or superior to the specified item.3 The proposed substitution does not affect dimensions shown on the drawings.4 The proposed substitution will have no adverse affects on other trades, the construction schedule, or any specified warranty requirements.5 Maintenance and service parts will be locally available for the proposed substitution. (GC shall provide supporting documentation in the attachments section below.)6 The General Contractor shall be responsible for any and all costs associated with this substitution request if approved. This includes but is not limited to fees for building design, engineering design fees, detailing fees, plan review fees, construction costs, and inspection fees.	
GC Substitution Request:	
General Title:	<input type="text"/>
Related Specification:	<input type="text"/> <input type="text"/> <input type="text"/>
Reason for Substitution:	<input type="text"/>
Proposed Substitution: (include Name, Model, etc.)	<input type="text"/>
Submitted By:	<input type="text"/>
Company:	<input type="text"/>
Phone:	<input type="text"/>
Email:	<input type="text"/>

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

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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

56
57

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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8 1.4. QUALITY ASSURANCE 2
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10 2.1. CONSTRUCTION BULLETIN FORM 2
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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8 1.4. CONTRACT EXTENSION 3
9 1.5. OVERHEAD AND PROFIT MARKUP 3
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11 1.7. QUALITY ASSURANCE 4
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15 3.1. ESTABLISHING A CHANGE ORDER REQUEST 4
16 3.2. SUBMIT A CHANGE ORDER REQUEST FORM 4
17 3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING 5
18 3.4. EMERGENCY CHANGE ORDER REQUEST 5
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.
53 F. OVERHEAD AND PROFIT Markup: The allowable markup percentage to a COR by the GC and Sub-contractors for
54 overhead and profit. All of the following are expenses associated with overhead and profit and shall not be
55 reimbursable as individual items on any COR:
56 1. CHANGE ORDER PREPARATION: All costs associated with the preparing and processing of the change
57 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
- 49 b. Labor rates
- 50 1. Labor rates shall be submitted on the form provided by the City prior to the GC
- 51 submitting a COR.
- 52 c. Material costs
- 53 d. Equipment costs
- 54 C. The following shall apply to establishing prices for labor, materials, and equipment costs:
- 55 1. Where Work to be completed has previously been established by individual bid items in the contract bid
- 56 proposal the GC shall use the unit bid prices previously established.
- 57 2. Where Work to be completed was bid as a Lump Sum without individual bid items the GC shall provide a
- 58 breakdown of all labor, materials, equipment including unit rates and quantities required.

- 1 D. The completion date is determined by Owner. The schedule, however, is the responsibility of the GC. Time
2 extensions for extra Work will be considered when a schedule analysis of the critical path shows that the Change
3 Order Request places the Work beyond the completion date stated in the Contract.
4

5 **1.7. QUALITY ASSURANCE**

- 6 A. The GC shall be responsible for ensuring that all COR supporting documentation meets the following
7 requirements prior to completing the COR form on the Project Management Web Site:
8 1. Sufficiently indicates labor, material, and other expenses related to completing the intent of the CB.
9 2. No costs exceed the usual and customary amount for such items available in the geographical area of the
10 project, and no costs exceed those established under the contract.
11 B. The Project Architect (PA), Commissioning Agent (CxA), City Project Manager (CPM), other members of the
12 consulting staff, and city staff shall review all COR requests to ensure that the intent of the CB will be met under
13 the proposal of the COR or request additional information as necessary.
14

15 **PART 2 – PRODUCTS**

16
17 **2.1. CHANGE ORDER REQUEST FORM**

- 18 A. The COR form is located on the Project Management Web Site. The GC shall click the link in the left margin of
19 the project web site opening a new form. Follow additional instructions below in the execution section for filling
20 out the form.
21

22 **PART 3 - EXECUTION**

23
24 **3.1. ESTABLISHING A CHANGE ORDER REQUEST**

- 25 A. Upon receipt of a Construction Bulletin (CB) where the GC believes a significant change in contract scope
26 warrants the submittal of a COR the GC shall do all of the following within ten (10) working days after receipt of
27 the CB:
28 1. Review the CB with all necessary trades and sub-contractors required by the change in scope.
29 a. Additions or deletions to the contract scope shall be as directed within the CB.
30 b. Additions or deletions of labor and materials shall be determined by the GC based on the
31 directives of the CB.
32 2. Assemble all required back-up documentation for additions and deletions of materials, labor and other
33 related contract costs as previously outlined in this specification.
34 3. Submit a COR request form on the Project Management Web Site.
35 B. Submitting a COR does not obligate the GC to complete the work associated with the COR nor does it obligate
36 the Owner to approve the COR as a change to the contract.
37

38 **3.2. SUBMIT A CHANGE ORDER REQUEST FORM**

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

1 D. When all data has been entered and verified click on the "Submit COR" button. This will kick off the COR Review
2 and Approval process.
3

4 **3.3. CHANGE ORDER REQUEST REVIEW, APPROVAL, AND PROCESSING**

- 5 A. The PA and CPM shall review all CORs submitted by the GC.
6 1. Additional consulting staff and city staff having knowledge of the components of the COR shall review
7 and advise the PA and CPM as to the accuracy of the items, quantities, and associated costs of the COR as
8 directed by the CB.
9 2. The CPM shall review the COR with the Owner.
10 B. If required the PA and CPM, shall in good faith, further negotiate the COR with the GC as necessary. All
11 amendments to any COR shall be documented within the Project Management Web Site software.
12 C. After final review of the COR the CPM and Owner may accept the COR.
13 D. The CPM shall prepare the COR in the form of an official Board of Public Works Change Order for final review and
14 approval as outlined in Section 01 26 63 Change Order (CO).
15 E. The GC shall not act upon any accepted COR until it has received final approval through the Public Works process
16 as an official CO to the Work unless instructed to do so by the CPM. Proceeding without the final approval of a
17 fully authorized Change Order is at the GC's own risk.
18

19 **3.4. EMERGENCY CHANGE ORDER REQUEST**

- 20 A. In the event Work is required due to an emergency as described in the Contract Documents, the GC must
21 request an equitable adjustment as soon as practicable, and in no case later than ten (10) working days of the
22 commencement of such emergency.
23 B. The GC shall provide full documentation of all labor, materials and equipment used during the period of
24 emergency as part of the COR submittal.
25
26
27

28 **END OF SECTION**
29

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

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4 PART 1 – GENERAL 1
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6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. BOARD OF PUBLIC WORKS PROCEDURE 1
8 PART 2 – PRODUCTS..... 2
9 2.1. CHANGE ORDER FORM..... 2
10 PART 3 - EXECUTION 2
11 3.1. PREPARATION OF THE CHANGE ORDER 2
12 3.2. EXECUTION OF THE CHANGE ORDER 2
13

PART 1 – GENERAL

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

1.2. RELATED SPECIFICATION SECTIONS

- 28
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

1.3. BOARD OF PUBLIC WORKS PROCEDURE

- 35
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 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**
49

**SECTION 01 29 73
SCHEDULE OF VALUES**

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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

PART 1 – GENERAL

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

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

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
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31 **END OF SECTION**
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SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

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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 	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
<ul style="list-style-type: none"> SBE Reports 		
Construction Progress Milestones <ul style="list-style-type: none"> Construction/Contract Closeout Meeting #1 Submittals/Re-submittals complete Meeting(s) to complete review of door hardware submittal(s). 	50% CT	<ul style="list-style-type: none"> Specification 01 31 19 Specification 01 33 23 Specification 08 71 00 (and similar)
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	This is a recommendation to the GC and is not a requirement of this PP. <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	Contractor to determine the proper order of completion: <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 	Final	<ul style="list-style-type: none"> Specification 01 77 00

Progress Payment (PP) Milestone Schedule		
Milestone Description	Due Before	Remarks
<ul style="list-style-type: none"> All BPW contractual requirements are verified 		<ul style="list-style-type: none"> 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		

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1.5. PROGRESS PAYMENT SUBMITTAL

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

PART 2 - PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. GENERAL CONTRACTOR PROCEDURE

- A. The GC shall provide an updated version of his/her schedule of values (AIA documents G702 & G 703) with each PP request.
 - 1. The AIA - Application and Certificate for Payment (G702) shall be properly filled out and prepared for the Architects review. See specification 01 29 73, Schedule of Values for more information.
 - 2. The AIA - Continuation sheets (G703) shall be properly filled out and indicate the dollar value of the completed work to date for each item on the form. See specification 01 29 73, Schedule of Values for more information.
 - a. The GC shall subtotal the work completed to date for all of the original Schedule of Value items.
 - b. Divide the sub total of work completed by the Original Contract Total to obtain a percentage complete of the original Lump Sum Bid. This percentage may be taken out to five (5) decimal places (round fifth place up or down as needed).
 - i. Example: \$5,192.55 of completed work divided by \$10,000 original Contract Total = 0.519255, round this to 0.51926
 - c. Write the percentage in Column 10 on the City Tabular Sheet for the original lump sum bid item in RED ink.
 - 3. Ensure that any newly posted change orders from the City of Madison provided tabulation sheet have been entered on the G703 continuation sheets. Repeat steps a thru c above for each change order on the schedule of values and the City Tabular Sheet.

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

25
26 **3.2. PROJECT ARCHITECT PROCEDURE**

- 27 A. The PA shall review the AIA-continuation sheets provided by the GC to determine if the Schedule of Values
28 accurately reflects the work completed for the inclusive dates indicated.
29 B. The PA shall advise the CPM of any discrepancies in the schedule of values.
30 C. The PA shall work with the GC and the CPM to resolve any issues prior to signing the AIA - Application and
31 Certificate for Payment.
32 D. When verified, the PA shall digitally sign the original PDF version of the AIA - Application and Certificate for
33 Payment on the Project Management Web Site.
34

35 **3.3. CITY PROJECT MANAGER PROCEDURE**

- 36 A. The CPM shall review all documents submitted by the GC and work with the PA to ensure the schedule of values
37 accurately reflects the work completed to date.
38 B. The CPM may elect to hold processing of any progress payment pending submittal of required progress payment
39 milestones.
40 C. When verified, the CPM shall digitally sign the City Cover Sheet and forward the required documentation to the
41 appropriate City agencies for further processing of the payment request.
42 D. The CPM shall add a scanned copy of any documents indicating the PP request processing was completed to the
43 PMWS.
44
45

46 **END OF SECTION**
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**SECTION 01 31 13
PROJECT COORDINATION**

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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
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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

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

- 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

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

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1.2. SHAREPOINT PROCEDURE OVERVIEW 1
1.3. RELATED SPECIFICATIONS 2
PART 2 - PRODUCTS 2
2.1. SHAREPOINT SYSTEM RELATED PRODUCTS 2
PART 3 - EXECUTION 2
3.1. POST BID-OPENING 2
3.2. POST PRE-CONSTRUCTION MEETING 3

PART 1 – GENERAL

1.1. GENERAL DESCRIPTION

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

1.2. SHAREPOINT PROCEDURE OVERVIEW

- A. The CoM PMT is a system of consolidated Document & Form Libraries and Data Lists that assist in performing day to day functions of design/construction management while reducing the use of surface mail, email and email attachments.
 - 1. Document libraries store a wide variety of documents in many different formats including but not limited to Word, Excel, PDF, photographs (all popular formats), etc.
 - 2. Data Lists contain consolidated data information that can be generated and stored for further use. Punch Lists and Warranty issues will be examples of Data Lists.
 - 3. Form Libraries are primarily used when a specific work flow process is needed. The form acts as the cover letter. An example of this would be the Submittal Review Process.
 - 4. Libraries are controlled by Permission Groups and Permission Levels.
- B. The following libraries and sub-libraries on the PMWS are provided for specific workflows and contract documentation. Related specification numbers are in "()" if applicable.

Contract Documents	Construction Administration	Construction Progress	LEED Documentation	Quality Control	Construction Closeout
<i>GC Partial Pay Apps (01 29 76)</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>Construction Documents</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>Regulatory 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>Testing Contract</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>Submittals (SUB Form) (01 33 23)</i>			<i>Safety and Incident Reports</i>	<i>Attic Stock (01 78 23)</i>
	<i>Substitution Request (SR Form) (01 25 13)</i>			<i>Material Testing & Field Reports</i>	<i>Demonstration and Training (01 79 00)</i>

Contract Documents	Construction Administration	Construction Progress	LEED Documentation	Quality Control	Construction Closeout
					Warranty Issues (WI Form) (01 78 23)

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

1.3. RELATED SPECIFICATIONS

- A. The following specification sections are directly related to the CoM PMT system.
 - 1. 01 25 13 Product Substitution Procedures
 - 2. 01 26 13 Request for Information (RFI)
 - 3. 01 26 46 Construction Bulletins (CB)
 - 4. 01 26 57 Change Order Request (COR)
 - 5. 01 26 63 Change Order (CO)
 - 6. 01 29 76 Progress Payment Procedures
 - 7. 01 31 19 Project Meetings
 - 8. 01 32 16 Construction Progress Schedules
 - 9. 01 32 26 Construction Progress Reporting
 - 10. 01 32 33 Photographic Documentation
 - 11. 01 33 23 Submittals
 - 12. 01 45 16 Field Quality Control Procedures (Owner)

PART 2 - PRODUCTS

2.1. SHAREPOINT SYSTEM RELATED PRODUCTS

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

PART 3 - EXECUTION

3.1. POST BID-OPENING

- A. After bids have been opened, a successful bidder has been determined, and bid acceptance procedures have been initiated the City Project Manager (CPM) will contact the GC to provide the following information.
 - 1. Project Management Software Tutorial. This tutorial is in a PDF printable format with screen shots and associated instructions on how to access and use the PMT.
 - a. Tutorial instructions will include but not be limited to the following:
 - i. Descriptions of various libraries, documents, and forms that will be used throughout the construction project.
 - ii. Uploading procedures for various types of documents including standardized naming conventions.

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2. A blank Project Directory in an Excel spread sheet format. The contractor shall provide the following information for GC and SC staffs as indicated on the spreadsheet. This will generally be the Project Manager for the GC as well as the Sub-contractors and the GC Site Supervisor.
 - a. Last Name, First Name
 - b. Company Name
 - c. Email address (valid, work related)
 - d. Work Phone Number (required, include area code)
 - e. Cell Phone Number (not required, include area code)
 3. The GC shall provide the above information for all SC's where the GC is not self-performing the work.
 4. The GC may provide project foreperson information for work being self-performed if he/she so desires.

12 **3.2. POST PRE-CONSTRUCTION MEETING**

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

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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.
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END OF SECTION

**SECTION 01 32 19
SUBMITTALS SCHEDULE**

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7 1.3. RELATED DOCUMENTS 1
8 1.4. SUBMITTAL DEFINITIONS 1
9 1.5. SUBMITTAL REQUIREMENTS 2
10 1.6. ADMINISTRATIVE SUBMITTALS 2
11 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
12 PART 3 - EXECUTION 2
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14 3.2. GENERAL CONTRACTORS RESPONSIBILITIES 2
15 3.3. STAFF REVIEW RESPONSIBILITIES 3
16

17 **PART 1 – GENERAL**

18
19 **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

30 **1.2. RELATED SPECIFICATIONS**

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

36 **1.3. RELATED DOCUMENTS**

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

47 **1.4. SUBMITTAL DEFINITIONS**

- 48 A. Administrative Submittal: Any submittal that may be required by a Division 1 Specification and as noted in
49 Section 1.5 below.
50 B. Critical Path Submittal: Any early submittal that needs a priority review due to early construction use or long
51 lead times where a delay could affect the critical path of the construction schedule
52 C. Submittal: Any material, product, equipment, or general requirement as outlined in this and other specifications
53 that require a favorable review or acceptance prior to proceeding with procuring the item or proceeding with
54 the Work.
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 23
SURVEY AND LAYOUT DATA**

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6 1.2. RELATED SPECIFICATIONS 1
7 1.3. SURVEYOR QUALIFICATIONS 1
8 1.4. QUALITY ASSURANCE 1
9 1.5. SUBMITTALS 2
10 1.6. EXAMINATION 2
11 PART 2 – PRODUCTS – NOT USED 2
12 PART 3 - EXECUTION 2
13 3.1. PRE-CONSTRUCTION OWNER SUPPORT 2
14 3.2. UTILITY LOCATING 2
15 3.3. SURVEY CONTROL AND LAYOUT DATA 2
16 3.4. TOPOGRAPHIC SURVEYING 2
17 3.5. SITE SURVEY AS-BUILT 3
18

PART 1 – GENERAL

1.1. SUMMARY

- 22 A. The purpose of this specification is to set forth the minimal required guide lines to be followed by the General
23 Contractor (GC) and the Land Surveyor (Surveyor) including but not limited to the following:
24 1. Surveyor Professional Requirements
25 2. Horizontal and Vertical Datum Control
26 3. Local Control (if any)
27 4. Electronic File and Data Requirements
28 5. As-Built Documentation Requirements
29 B. When working on any City of Madison project, OSHA standards must be complied with. The Surveyor shall
30 provide appropriate traffic control in accordance to the Manual on Uniform Traffic Control Devices (MUTCD).
31 C. The Surveyor shall be responsible for notifying Diggers Hotline in advance of beginning the field work for this
32 contract.
33

1.2. RELATED SPECIFICATIONS

- 34 A. Section 01 29 76 Progress Payment Procedures
35 B. Section 01 31 23 Project Management Web Site (SharePoint)
36 C. Section 01 33 23 Submittals
37 D. Section 01 78 39 As-Built Drawings
38 E. Section 105.9, Survey Points and Instructions, of the City of Madison Standard Specifications for Public Works
39
40

1.3. SURVEYOR QUALIFICATIONS

- 41 A. The General Contractors, Land Surveyor Sub-Contractor shall meet or exceed the following:
42 1. The Principal Land Surveyor (PLS) shall be licensed to practice in the State of Wisconsin.
43 a. The PLS's license shall be current at the beginning of the contract and the PLS shall maintain an
44 active license throughout the execution of this contract.
45 2. The PLS shall have a minimum of minimum of ten (10) years of field experience on similar projects of
46 scope and size.
47 a. Land Surveyors working under the direction of the PLS shall have a minimum of five (5) years of field
48 experience on similar projects of scope and size.
49 B. The PLS shall be responsible for checking and verifying all work being performed under the PLS's direction during
50 the execution of this contract. This shall include but not be limited to periodic field checks of equipment and
51 survey data for accuracy and compliance with the contract documents.
52
53

1.4. QUALITY ASSURANCE

- 54 A. The PLS shall do all surveying in City of Madison Datum's as follows:
55 1. All Horizontal Control shall be in the Dane County Coordinates (WISCRS), NAD 83(1997) datum, US
56 Survey foot).
57 2. All Vertical Control shall be in NAVD88(1991).
58

- 1 3. Information on PLSS Section Corner Monuments and Tie Sheets can be found on the City Engineering
2 Mapping website http://gis.cityofmadison.com/Madison_PLSS/PLSS_TieSheets.html.

3
4 **1.5. SUBMITTALS**

- 5 A. After initial project setup the PLS shall provide the following information as a Survey Data Submittal for review
6 by the CPM/CCM, and Owner. See Specification 01 33 23 – Submittals for more information.
7 1. Copy of the PLS (and any supporting staff) current State of Wisconsin registration certificate/licenses.
8 2. Digital Survey Submittal on a thumb drive delivered to the CPM/CCM. Submittal Survey shall be on a
9 thumb drive or CD in Auto CAD 2017, MicroStation V8i, or DXF format. Digital Submittal shall be of the
10 project site setup showing all of the following:
11 a. Key features not scheduled for demolition, including but not limited to building corners, roof
12 overhangs, and door locations.
13 b. Location of construction limits fencing.
14 c. Locations of PLSS and/or project control points provided by the Owner.
15 d. Locations of project based control points.
16 3. Printed Survey Submittal shall be the same as item 1 above in PDF format. PDF file shall be formatted to
17 print to scale on 24"x36" sheets as required to show all features with text neatly organized for each item
18 identified. When multiple sheets are used a match line and sheet references shall be required.
19 4. PDF file of the complete level/layer scheme. Scheme shall be in tabular form formatted to 8.5 by 11
20 paper and shall include all of the following:
21 a. Level/layer designation (abbreviation).
22 b. Level/layer designation (full title).
23 c. Feature attribute characteristics (line weight, line style, font, etc.).
24 d. Cell attribute information
25 e. Samples of line styles and cells.

26
27 **1.6. EXAMINATION**

- 28 A. The PLS shall be responsible for verifying all site data including the owner provided local control points (see
29 Section 3.1 below) prior to starting the Work.
30 B. Notify the Project Architect and CPM/CCM immediately if any discrepancies are discovered.

31
32 **PART 2 – PRODUCTS – NOT USED**

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34 **PART 3 - EXECUTION**

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36 **3.1. PRE-CONSTRUCTION OWNER SUPPORT**

- 37 A. The CPM/CCM shall provide the GC/PLS with a digital CAD seed file on or before the Pre-construction meeting.
38 1. Seed file shall be a MicroStation 3D seed file using the datum indicated above. Seed file shall be
39 delivered as a MicroStation V8i or DXF format as requested by the PLS.
40 a. Seed file shall be used as the PLS's initial base file for all future work on this contract.

41
42 **3.2. UTILITY LOCATING**

- 43 A. The GC and/or PLS shall be responsible for notifying Diggers Hotline for all utility locate requests.
44

45 **3.3. SURVEY CONTROL AND LAYOUT DATA**

- 46 A. The GC and PLS are responsible for all other survey control and layout data required to perform the work in this
47 contract.

48
49 **3.4. TOPOGRAPHIC SURVEYING**

- 50 A. The Surveyor may perform the topographic survey with properly calibrated equipment as follows:
51 1. Total station, achieving minimum accuracy for well-defined features of +/- 0.1 feet horizontal and +/-0.04
52 feet vertical at 95% confidence relative to control. "Well defined features" shall include but not be
53 limited to property irons, pavements, trees, landscaping features, buildings, utility locations, and other
54 permanent features.
55 2. RTK GPS shall be permitted in large open areas, along tree lines, and in brushy areas.
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3.5. SITE SURVEY AS-BUILT

- A. See Specification 01 78 39 As-Built Drawings, Section 3.2 for more information on required record site information to be provided prior to contract closeout.
- B. The GC shall be responsible for scheduling the PLS to capture locations and depths of all buried utilities prior to any contractor back filing trenches. The Owner may require missing information to be located and surveyed at the GC's expense.

END OF SECTION

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SECTION 01 32 26
CONSTRUCTION PROGRESS REPORTING

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8 PART 2 – PRODUCTS - THIS SECTION NOT USED 1
9 PART 3 - EXECUTION 1
10 3.1. CONTRACTOR 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

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.

PART 2 – PRODUCTS - THIS SECTION NOT USED

PART 3 - EXECUTION

3.1. CONTRACTOR JOURNAL

- 38 A. The GC shall maintain a journal of daily progress on which Work is performed by any employee or entity for
39 which the GC is responsible. Such reports shall include all relevant data concerning the progress of Work
40 activities the GC and Subcontractors are responsible for and the effect of that activity on the time of
41 performance of the Contract.
42 1. Some projects may not require weekly journals be kept instead of daily journals. This is at the sole
43 discretion of the City Project Manager. A daily journal will generally be required when the contract has a
44 significant amount of site work. A weekly journal will generally be used when a contract is interior work
45 only.
46 B. Journal entries shall be made on the Contractor Daily/Weekly Report Form located in the Construction Progress-
47 Daily Journal Library on the Project Management Web Site. The form consists of the following areas:
48 1. Weather; include temperature, humidity, precipitation, wind and other related information such as
49 significant storm events, times, and details.
50 2. Work completed by trade
51 3. Delays encountered
52 4. Deliveries received or delayed
53 5. Hot issues that need to be addressed
54 6. Safety issues
55 7. Photograph progress and upload to the Photo Library on the Project Management Web Site.
56 8. Other including inspections, testing, etc.
57 9. Space for attaching documents

- 1 C. Contractor Daily/Weekly Report Forms shall be completed and signed by the GC's Job Superintendent or other
2 on-site representative authorized by the GC confirming each such report is current, accurate and complete.
3 D. If applicable the GC shall include schedules of quantities and costs, progress schedules, wage rates, reports,
4 estimates, invoices, records and other data as requested by the CPM concerning Work performed or to be
5 performed under this Contract if the CPM determines such information is needed to substantiate Change Order
6 proposals, claims, or to resolve disputes.
7

8 **3.2. CONSTRUCTION PROGRESS MEETINGS**

- 9 A. The GC shall provide a verbal summary of the previous two (2) weeks progress reports at each bi-weekly
10 construction progress meeting.
11

12 **END OF SECTION**
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**SECTION 01 32 33
PHOTOGRAPHIC DOCUMENTATION**

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6 1.2. RELATED SPECIFICATION SECTIONS 1
7 1.3. SUBMITTALS 1
8 PART 2 – PRODUCTS 1
9 2.1. DIGITAL CAMERA 1
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11 PART 3 – EXECUTION 2
12 3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS 2
13 3.2. REQUIREMENTS FOR TIME LAPSE PHOTOGRAPHS 2
14 3.3. PROJECT MANAGEMENT WEB SITE (SHAREPOINT) 2
15

16 **PART 1 – GENERAL**

17
18 **1.1. SCOPE**

- 19 A. The General Contractor (GC) shall be required to take weekly digital photographs of interior and exterior
20 construction progress and upload the photos directly to the Project Management Web Site (SharePoint).
21 B. The GC shall be required to provide digital time-lapse photo service of the project exterior construction progress.
22

23 **1.2. RELATED SPECIFICATION SECTIONS**

- 24 A. Section 01 29 76 Progress Payment Procedures
25 B. Section 01 31 23 Project Management Web Site (SharePoint)
26 C. Section 01 32 19 Submittals Schedule
27 D. Section 01 32 33 Submittals
28 E. Section 01 77 00 Closeout Procedures
29

30 **1.3. SUBMITTALS**

- 31 A. The GC shall provide general information on the type of camera being used for interior and exterior digital
32 photographs.
33 1. Information may be written on Contractor’s transmittal sheet.
34 a. Include camera name/type, aspect ratio setting, and average file size
35 b. Provide sample project pictures as part of PDF submittal.
36 B. The GC shall provide sufficient information on the type of time lapse system being used that meets the
37 requirements identified in section 2.2 below.
38

39 **PART 2 – PRODUCTS**

40
41 **2.1. DIGITAL CAMERA**

- 42 A. All digital photographs shall be taken with a good quality digital camera, cell phone, tablet, and other such digital
43 device.
44 B. Digital photographs shall be formatted to achieve a good, clear, and detailed image where the final file size is
45 between 600 KB and 3.0 MB (3000KB).
46

47 **2.1. TIME LAPSE CONSTRUCTION CAMERA (TLCC)**

- 48 A. The TLCC shall be a high quality weather proof camera owned and operated, or leased, by the GC for the
49 duration of this contract with the following minimum capabilities:
50 1. Pan-Tilt-Zoom (PTZ) capable.
51 2. Wireless internet or built in cellular technology capable.
52 a. The use of memory cards will not be permitted.
53 3. Widescreen, high resolution (5-30 MP rating).
54 4. Powered by 120V AC.
55 a. The use of battery packs will not be permitted.
56 5. Web/cloud hosted access to archived photos and video.
57 6. Provides complete time lapse video capability.
58 7. 24/7 service and support for equipment, software, and hosting services.

- 1 B. Approved equipment/services include but are not limited to the following:
2 1. OxBlue Corporation, www.oxblue.com
3 2. EarthCam, www.earthcam.net
4 3. TrueLook, www.truelook.com
5

6 **PART 3 – EXECUTION**

7 8 **3.1. REQUIREMENTS FOR DIGITAL PHOTOGRAPHS**

- 9 A. The GC shall take a minimum of two (2) exterior photographs each week. Exterior photographs will not be
10 required on projects that do not include any exterior work.
11 1. Exterior photos shall be taken from approximately the same location each week for the duration of the
12 project.
13 2. When applicable this requirement shall begin prior to commencing any site work.
14 3. This requirement shall only be applicable when there is exterior work actively being conducted with the
15 project. Periods of inactivity due to weather (winter conditions) do not require a photograph.
16 4. This requirement shall end when the exterior work has been substantially completed.
17 5. This requirement may be suspended due to weather conditions or substantial delays in exterior progress.
18 B. The GC shall take interior photographs each week that document interior construction progress.
19 1. This requirement will begin when exterior wall framing begins.
20 a. When an interior remodeling project includes demolition work interior photos shall be taken
21 during the demolition process.
22 2. Pictures do not need to be taken from the same location each week.
23 3. This requirement shall end when the interior work has been substantially completed.
24 C. Digital photographs shall be properly zoomed in/out, and flash used as needed, to capture a level of detail
25 required to properly show the progress being captured by the photograph.
26 1. Blurry and dark pictures will not be accepted.
27 D. The camera default naming convention is acceptable. The GC does not need to rename or specifically identify
28 pictures with a title.
29 E. All digital photographs shall be saved in a JPEG (.jpg) format and uploaded directly to the SharePoint Project
30 Images Library.
31 1. The GC shall upload the photos to the folder that designates the appropriate construction week and date
32 (beginning Monday date). If no folder exists, contact the CPM/CCM prior to uploading photos.
33

34 **3.2. REQUIREMENTS FOR TIME LAPSE PHOTOGRAPHS**

- 35 A. The GC shall be responsible for all of the following:
36 1. Verify with the CPM/CCM a suitable place for mounting the camera and related equipment prior to
37 installation.
38 2. The complete installation, setup, maintenance, and removal of the camera and related equipment.
39 3. The hosting and access of all photographs and videos taken by the camera during the project.
40 4. Production of a final time lapse video (minimum of 3 minutes in length) of the project provided in a
41 viewable format to the Owner on a thumb drive or CD.
42 B. Time lapse photos shall be taken from the same fixed position at approximately ten (10) minute intervals.
43 1. Time lapse shall start before normal daily activities begin and end after normal daily activities have been
44 completed.
45 a. The GC shall adjust the camera time lapse schedule as needed to accommodate any periods of
46 overtime or weekend work.
47 b. Time lapse shall not be taken during major periods of no activity including night hours, holidays,
48 weather related (winter) inactivity, etc.
49 C. All photos taken during the execution of this contract shall be accessible from a web based service. Archived
50 photos shall be organized by date and time so that they can be easily retrieved and viewed as needed.
51 1. If necessary the GC shall coordinate usernames and passwords for access to the photos. The City of
52 Madison would prefer that the access be generic to accommodate a wide audience.
53

54 **3.3. PROJECT MANAGEMENT WEB SITE (SHAREPOINT)**

- 55 A. The CPM/CCM shall provide weekly progress folders in the Project Images Library on SharePoint.
56 1. Progress folders are labeled with the Construction Week Number and the date for Monday of that week.
57 2. The GC shall notify the CPM/CCM if additional weekly progress folders need to be created.

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- B. The GC shall upload the weekly digital photographs to the appropriate progress folder in the Project Images Library.
- C. Copies of Time Lapse video shall be uploaded to a separate project folder in the Project Images Library prior to Construction Closeout.

END OF SECTION

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**SECTION 01 33 23
SUBMITTALS**

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7 1.3. SUBMITTAL REQUIREMENTS 1
8 PART 2 – PRODUCTS – THIS SECTION NOT USED 2
9 PART 3 - EXECUTION 2
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.
- 56

1 **3.2. SUBMITTAL REVIEW**

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

10
11 **3.3. PROJECT ARCHITECTS REVIEW**

- 12 A. Upon completion of the internal review the Project Architect shall review all internal review comments, confer
13 with the CPM and CxA as needed and determine the appropriate disposition status for the submittal (approved
14 or resubmit).
15 C. The Project Architect shall summarize final internal review comments onto the submittal cover sheet, provide a
16 final disposition of the submittal and update the review status of the submittal to "Complete..." (with or w/o
17 comments) or "Rejected".
18 D. A completed Final Review status initiates the PMWS to notify the GC and appropriate sub-contractor(s) that the
19 review of the submittal has been completed.
20
21
22

23 **END OF SECTION**
24

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**SECTION 01 43 39
MOCKUPS**

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PART 1 – GENERAL

1.1. SUMMARY

- A. Definition
1. Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner, Owners Representative, Architect and Consultants.
 2. 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.
1. All plans, specifications, and details including those derived as revisions (RFI, CB, CO).
 2. 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.
 3. 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:
1. Designating the location for the mockup construction
 2. Coordinating the work of all contractors and materials required to complete the mockup
 3. Ensuring that the mockup meets the intent of the construction documents before scheduling the mockup review meeting.

1
2 **PART 2 - PRODUCTS**

3
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.
11

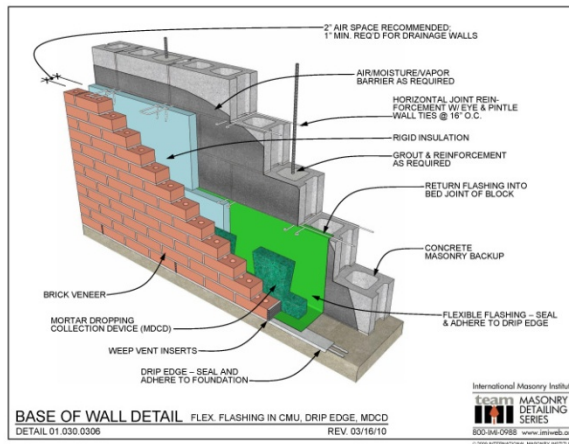
12 **PART 3 - EXECUTION**

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. **REQUIRED MOCKUPS:**
32 1. Linear acoustic wood ceiling (section 09 51 00)
33 2. Porcelain ceramic tile (section 09 30 00)
34

35 **3.3. MOCKUP REVIEW**

- 36 A. The General Contractor and all associated Sub-contractors (Contracting Team) shall meet with the Owner,
37 Owners Representative, Architect and Consultants (Design Team) as necessary to review the mock-up.
38 Contractors shall be prepared to answer questions on materials and methods as necessary.
39 B. The Contracting and Design Teams shall review the mockup in detail for materials, methods, and workmanship
40 with respect to the intent of the contract documents. Improvements or adjustments shall be discussed as
41 needed.
42 C. If the mockup is incomplete or does not show sufficient detail of products and workmanship the General
43 Contractor shall resubmit a new mockup.

- 1 D. Re-submittal of mockups to meet the intent of the contract documents shall be the responsibility of the General
2 Contractor. No Change Orders will be processed for additional time or materials associated with re-submitting a
3 mockup for approval.
4 1. In the event that a submitted mockup meets the criteria of the contract documents but does not meet
5 the expectations of the design team and alternative methods or materials are discussed the following
6 procedure shall be used:
7 a. Project Architect shall publish a Construction Bulletin (CB) to detail the required/recommended
8 changes.
9 b. The GC shall prepare and submit a new mockup.

10

11 **3.4. FINAL SUBMITTAL**

- 12 A. The field approved mockup shall be submitted by the General Contractor as any other submittal for project
13 documentation purposes. The mockup submittal shall consist of the following:
14 1. Digitally photograph the field approved mockup. Take as many detailed photos as necessary to capture
15 the complexity of the mockup.
16 2. Provide a written summary of the approved mockup. Include all recommended adjustments, level of
17 expected workmanship, and other such detail as discussed during the mockup review.
18 3. Submit the mockup to the Project Management Web Site. See Specification 01 33 23 Submittals for
19 additional information.
20

21

22

23

24

END OF SECTION

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**SECTION 01 43 50
AIR BARRIER SYSTEMS**

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16

PART 1 – HEADING 1

1.1. RELATED DOCUMENTS

- 19
20 A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division
21 01 Specification Sections, Division 07 Specification Sections, apply to this Section.
22

1.2. SUMMARY

- 23 A. Contractor will engage a qualified consultant(s) to perform tests and inspections prior to the installation of air
24 barrier components.
25 B. This section includes administrative and procedural requirements for accomplishing an airtight building
26 enclosure that controls infiltration or exfiltration of air.
27 C. Related Sections:
28 1. Section 07 25 00: Weather Barriers.
29 2. Requirements of this section relate to the coordination between subcontractors required to provide an
30 airtight building enclosure, customized fabrication and installation procedures, not production of
31 standard products.
32
33

1.3. DEFINITIONS

- 34 A. Air Barrier System: The airtight components of the building enclosure and the joints, junctures and transitions
35 between materials, products, and assemblies forming the air-tightness of the building enclosure.
36 B. Services: Include coordination between the trades, the proper scheduling and sequencing of the work, pre-
37 construction meetings, inspections, tests, and related actions, including reports performed by Contractor, by
38 independent agencies, and by governing authorities. They do not include contract enforcement activities
39 performed by Architect.
40
41

1.4. PERFORMANCE REQUIREMENTS

- 42 A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a
43 continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air
44 barrier system shall have the following characteristics:
45 1. It shall be continuous, with all joints sealed.
46 2. It shall be structurally supported to withstand positive and negative air pressures applied to the building
47 enclosure.
48 3. Continuity of the air barrier materials and products with joints to provide complete assemblies.
49 4. Continuity of all the enclosure assemblies with joints and transition materials to provide a whole building
50 air barrier system.
51 B. Connection shall be made between:
52 1. Foundation and walls.
53 2. Walls and windows or doors.
54 3. Different wall systems.
55 4. Wall and roof.
56 5. Wall and roof over unconditioned space.
57 6. Walls, floor and roof across construction, control and expansion joints.
58

- 1 7. Walls, floors and roof to utility, pipe and duct penetrations.
2 C. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made
3 air-tight.
4 D. Compliance Requirements:
5 1. Assemblies: an air permeance not to exceed 0.03 cfm/ft²p under a pressure differential of 0.3 in. water
6 (1.57psf) (0.15 L/s.m² @ 75 Pa) when tested in accordance with ASTM E 1677.
7 2. Materials: Materials used for the air barrier system in the opaque envelope shall have an air permeance
8 not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57psf) (0.02 L/s.m² @ 75 Pa)
9 when tested in accordance with ASTM E 2178. Or,
10 3. Entire Building: The air leakage of the entire building shall not exceed 0.15 cfm/sf under a pressure
11 differential of 0.3 in. water (1.57psf) (0.75 L/s.m² @ 75 Pa) when tested according to ASTM E 779.
12

13 **1.5. SUBMITTALS**

- 14 A. Field quality-control reports.
15 B. Testing agency shall submit a certified written report, in duplicate, of each inspection, test, or similar service to
16 the Architect. If the Contractor is responsible for the service, submit a certified written report, in duplicate, of
17 each inspection, test, or similar service through the Contractor.
18 1. Submit additional copies of each written report directly to the governing authority, when the authority so
19 directs.
20 C. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, the
21 following:
22 1. Date of issue.
23 2. Project title and number.
24 3. Name, address, and telephone number of testing agency.
25 4. Dates and locations of samples and tests or inspections.
26 5. Names of individuals making the inspection or test.
27 6. Designation of the Work and test method.
28 7. Identification of product and Specification Section.
29 8. Complete inspection or test data.
30 9. Test results and an interpretation of test results.
31 10. Ambient conditions at the time of sample taking and testing.
32 11. Comments or professional opinion on whether inspected or tested Work complies with Contract
33 Document requirements.
34 12. Name and signature of laboratory inspector.
35 13. Recommendations on retesting.
36

37 **1.6. QUALITY ASSURANCE**

- 38 A. General Performance: The Contractor shall ensure that the intent of constructing the building enclosure with a
39 continuous air barrier system to control air leakage into, or out of the conditioned space is achieved. The air
40 barrier system shall have the following characteristics:
41 B. Inspection and testing services are required to verify compliance with requirements specified or indicated. These
42 services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
43 1. Qualifications for Air Barrier Testing and Inspection Agencies: Engage Air Barrier inspection and testing
44 service agencies, including independent testing laboratories, that are prequalified and that specialize in
45 the types of air barrier system inspections and tests to be performed.
46 C. Specific quality-control requirements for individual construction activities are specified in the sections of the
47 specifications. Requirements in those sections may also cover production of standard products. It is the
48 Contractor's responsibility to ensure that each subcontractor is adequately and satisfactorily performing the
49 quality assurance documentation, tests and procedures required by each section.
50 D. Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that
51 facilitate compliance with Contract Document requirements.
52

53 **1.7. PROJECT CONDITIONS**

- 54 A. Contractor Responsibilities: Unless otherwise indicated as the responsibility of another identified entity,
55 Contractor shall provide coordination of the trades, and the sequence of construction to ensure continuity of the
56 air barrier system joints, junctures and transitions between materials and assemblies of materials and products,
57 from substructure to walls to roof. Provide quality assurance procedures, testing and verification as specified
58 herein. Facilitate inspections, tests, and other quality-control services specified elsewhere in the Contract

- 1 Documents and required by authorities having jurisdiction or by the Owner. Costs for these services are included
2 in the Contract Sum.
- 3 B. Organize preconstruction meetings between the trades involved in the whole building's air barrier system to
4 discuss where each trade begins and ends and the responsibility and sequence of installation of all the air-tight
5 joints, junctures, and transitions between materials, products and assemblies of products specified in the
6 different sections, to be installed by the different trades.
- 7 C. Build a mock-up before proceeding with the work, satisfactory to the Architect, of each airtight joint type,
8 juncture, and transition between products, materials and assemblies.
- 9 D. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and
10 provide reasonable auxiliary services as requested. Notify the agency sufficiently in advance of operations to
11 permit assignment of personnel. Auxiliary services required include, but are not limited to, the following:
12 1. Provide access to the Work.
13 2. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
14 3. Take adequate quantities of representative samples of materials that require testing or assist the agency
15 in taking samples.
16 4. Deliver samples to testing laboratories.
17 5. Provide security and protection of samples and test equipment at the Project Site.
- 18 E. Duties of the Testing and Inspection Agency: The independent agency engaged to perform inspections, sampling,
19 and testing of air barrier materials, components and assemblies specified in individual Sections shall cooperate
20 with the Architect and the Contractor in performance of the agency's duties. The testing agency shall provide
21 qualified personnel to perform required inspections and tests.
22 1. The agency shall notify the Architect and the Contractor promptly of irregularities or deficiencies
23 observed in the Work during performance of its services.
24 2. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract
25 Documents or approve or accept any portion of the Work.
26 3. The agency shall not perform any duties of the Contractor.
- 27 F. Coordination: Coordinate the sequence of activities to accommodate required services with a minimum of delay.
28 Coordinate activities to avoid the necessity of removing and replacing construction to accommodate inspections
29 and tests.
30 1. The Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar
31 activities.
32

33 **PART 2 – PRODUCTS – NOT USED**

34
35 **PART 3 - EXECUTION**

36
37 **3.1. FIELD QUALITY CONTROL**

- 38 A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- 39 B. Tests and Inspections:
40 1. Qualitative Testing and Inspection:
41 a. Daily reports of observations, with copies to the Owner, Contractor and Architect.
42 b. Continuity of the air barrier system throughout the building enclosure with no gaps, holes.
43 c. Structural support of the air barrier system to withstand design air pressures.
44 d. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions and mortar
45 droppings, with mortar joints struck flush, or as required by the manufacturer of the air barrier
46 material.
47 e. Site conditions for application temperature and dryness of substrates.
48 f. Maximum length of exposure time of materials to ultra-violet deterioration.
49 g. Surfaces are properly primed.
50 h. Laps in material are 2" minimum, shingled in the correct direction (or mastic applied on exposed
51 edges), with no fishmouths.
52 i. Mastic applied on cut edges.
53 j. Roller has been used to enhance adhesion.
54 k. Measure application thickness of liquid-applied materials to manufacturer's specifications for the
55 specific substrate.
56 l. Materials used for compatibility.
57 m. Transitions at changes in direction, and structural support at gaps.

- 1 n. Connections between assemblies (membrane and sealants) for cleaning, preparation and priming
- 2 of surfaces, structural support, integrity and continuity of seal.
- 3 o. All penetrations sealed.
- 4 2. ASTM E 1186/98 "Standard Practices for Air Leakage Site Detection in Building Envelopes and Air
- 5 Retarder Systems."
- 6 a. Infrared scanning with pressurization/depressurization.
- 7 b. Smoke pencil with pressurization/depressurization.
- 8 c. Pressurization/depressurization with use of anemometer.
- 9 d. Generated sound with sound detection.
- 10 e. Tracer gas measurement of decay rate.
- 11 f. Chamber pressurization/depressurization in conjunction with smoke tracers.
- 12 g. Chamber depressurization using detection liquids.
- 13 3. Quantitative Tests: Provide written test reports of all tests performed, with copies to the Owner,
- 14 Contractor and Architect.
- 15 a. Material compliance for maximum air permeance, ASTM E 2178.
- 16 b. ASTM E 283, Determining rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors
- 17 under Specified Pressure Differences Across the Specimen.
- 18 c. Assemblies, ASTM E 1677, test pressure and allowable air leakage rate to be determined by design
- 19 professional for interior design conditions and location of project.
- 20 d. CAN/CGSB 1986 Standard 149.10, Determination of the Airtightness of Building Envelopes by the
- 21 Fan Depressurization Method.
- 22 e. CAN/CGSB 1996 Standard 149.15 Determination of the Overall Envelope Airtightness of Office
- 23 Buildings by the Fan Depressurization Method Using the Building's Air Handling System.
- 24 f. Canadian National Master Specification Sections 07272 Air Barrier Systems for Exterior Walls of
- 25 Low-Rise Buildings.
- 26 g. Canadian National Master Specification 07272.1 : Durability Assessment of Bead-Applied
- 27 Urethane-Based Sealant Foam for Air Barriers.
- 28 h. Whole building, floors, or suites, ASTM E779, Determining Airtightness of Buildings Air Leakage
- 29 Rate by Single Zone Air Pressurization.
- 30 i. Windows and connections to adjacent opaque assemblies, ASTM E783.
- 31 j. Tracer gas testing, ASTM E741.
- 32 k. Pressure test, ASTM E330.
- 33 l. Bond to substrate, ASTM D4541-95.
- 34 m. Minimum dry or wet film thickness for liquid-applied materials are per the manufacturer's
- 35 requirements.

36
37 **3.2. REPAIR AND PROTECTION**

- 38 A. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and
- 39 restore substrates and finishes. Comply with Contract Document requirements for Division 1 Section "Cutting
- 40 and Patching."
- 41 B. Protect construction exposed by or for quality-control service activities, and protect repaired construction.
- 42 C. Repair and protection is Contractor's responsibility, regardless of the assignment of responsibility for inspection,
- 43 testing, or similar services.
- 44
- 45
- 46
- 47
- 48

END OF SECTION

SECTION 01 45 16
FIELD QUALITY CONTROL PROCEDURES

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17

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**

42 **PART 3 - EXECUTION**

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

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

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.

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

3 **PART 2 – PRODUCTS – THIS SECTION NOT USED**
4

5
6 **PART 3 – EXECUTION – THIS SECTION NOT USED**
7

8
9 **END OF SECTION**

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

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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 (choose one) will provide the following:
9 1. Electrical power and metering, consisting of existing facilities.
10 2. Water supply, consisting of existing facilities.
11 B. General:
12 1. Existing facilities may be used.
13 2. New permanent facilities may be used.
14 C. Water Service: water is available from existing building services.
15 1. Use trigger-operated nozzles for water hoses, to avoid waste of water.
16 D. Temporary Electric Power Service: Electrical Contractor shall extend temporary power from existing building
17 services.
18 E. Temporary Lighting: Electrical Contractor shall provide temporary lighting with local switching
19 1. Install and operate temporary lighting, minimum of 30 fc, to fulfill security and protection requirements,
20 without operating the entire system, and will provide adequate illumination for all areas of work,
21 including construction operations and traffic conditions.
22 F. Temporary Heat: General Contractor shall provide temporary heat required by construction activities, for curing
23 or drying of completed installations or protection of installed construction from adverse effects of low
24 temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed
25 installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition
26 required and minimize consumption of energy.
27 1. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-
28 contained LP gas or fuel oil heaters with individual space thermostatic control.
29 a. Use of gasoline-burning space heaters, open flame, or salamander type heating units is
30 prohibited.
31

32 **1.5. TELECOMMUNICATIONS SERVICES AND WI-FI**

- 33 A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization through
34 construction closeout.
35 B. Telecommunications services shall include:
36 1. Windows-based personal computer dedicated to project telecommunications.
37 2. Shared access to the internet via WIFI or similar wireless connection.
38 a. Access must be capable to support minimum of 10 wireless devices.
39 3. Email Account/address dedicated for GC Project Manager of GC Supervisor on site.
40

41 **1.6. TEMPORARY SANITARY FACILITIES**

- 42 A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
43 B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and
44 maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
45 1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide
46 covered waste containers for used material.
47 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
48 C. Maintain daily in clean and sanitary condition
49 D. Water: Provide potable water approved by local health authorities
50

51 **1.7. BARRIERS**

- 52 A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be
53 hazardous to workers or the public and to protect existing facilities and adjacent properties from damage from
54 construction operations and demolition.
55

56 **1.8. FENCING**

- 57 A. Construction: Refer to Plan Documents and Specification Section 01 76 00: Fencing Materials and Barricades
58

1 **1.9. EXTERIOR ENCLOSURES**

- 2 A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions
3 and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures
4 identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors
5 with self-closing hardware and locks.
6

7 **1.10. SECURITY**

- 8 A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized
9 entry, vandalism, or theft.
10

11 **1.11. VEHICULAR ACCESS AND PARKING**

- 12 A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for
13 emergency vehicles.
14 B. Coordinate access and haul routes with governing authorities and Owner.
15 C. Provide and maintain access to fire hydrants, free of obstructions.
16 D. Existing parking areas located at (Insert location here) may be used for construction parking until PINNEY
17 NEIGHBORHOOD LIBRARY is occupied by Owner.
18

19 **1.12. WASTE REMOVAL**

- 20 A. See Section 01 74 19 - Waste Management, for additional requirements.
21 B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
22 C. Provide containers with lids. Remove trash from site periodically.
23 D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible
24 containers; locate containers holding flammable material outside the structure unless otherwise approved by the
25 authorities having jurisdiction.
26 E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
27

28 **1.13. PROJECT IDENTIFICATION**

- 29 A. Provide project identification sign of design and construction indicated in Section 01 58 13.
30 B. Erect on site at location determined by Owner .
31 C. No other signs are allowed without Owner permission except those required by law.
32

33 **1.14. FIELD OFFICES**

- 34 A. Office: Weather tight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy
35 furniture, drawing rack and drawing display table.
36 B. Field Office shall be located <xxxx> .
37 C. Provide space for Project Meetings with table and chairs to accommodate a minimum of fifteen (15) persons.
38 D. Provide a minimum of a 40" LCD monitor or other digital projection device to be connected to the computer
39 identified in Section 1.4 Telecommunications Services (above), for use during progress meetings in connection
40 with reviewing construction progress information posted to the Project Management Web Site (Specification 01
41 31 23) hosted by the Owner.
42

43 **PART 2 - PRODUCTS**

44
45 **2.1. TEMPORARY PARTITIONS**

- 46 A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and
47 noise.
48 1. Non-fire rated partitions, standard
49 a. Wood stud framing, 6-mil polyethylene
50

51 **2.2. EQUIPMENT**

- 52 A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting
53 materials and employees.
54 B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent
55 insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault
56 circuit interrupters, reset button and pilot light, for connection of power tools and equipment.
57 C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-
58 service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate

- 1 lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do
2 not exceed safe length-voltage ratio.
- 3 D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage
4 required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to
5 breakage. Provide exterior fixtures where exposed to moisture.
- 6 E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by
7 UL, FM or another recognized trade association related to the type of fuel being consumed.
- 8 F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.
- 9 G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA
10 recommended classes for the exposures, extinguishing agent and size required by location and class of fire
11 exposure.

12
13 **PART 3 - EXECUTION**

14
15 **3.1. TEMPORARY FIRE PROTECTION**

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

31
32 **3.2. COLLECTION AND DISPOSAL OF WASTE**

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

40
41 **3.3. ENVIRONMENTAL PROTECTION**

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

48
49 **3.4. REMOVAL OF TEMPORARY UTILITIES, FACILITIES, AND CONTROLS**

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

55
56
57
58 **END OF SECTION**

**SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE**

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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, City of Madison, Madison Public Library, Madison Public Library Foundation, 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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16 3.7. DUCTWORK, PIPING, AND CONDUIT 3
17 3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT 4
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

PART 2 – PRODUCTS – THIS SECTION NOT USED

PART 3 - EXECUTION

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.

1 2. After installation, free/open ends shall remain protected with taped plastic sheathing and or temporary
2 filters as specified by division or Trade specifications.

3
4 **3.8. OWNER PROVIDED, CONTRACTOR INSTALLED EQUIPMENT**

5 A. Section 3.8.A. shall apply to all equipment being provided to any contractor directly from the Owner for
6 installation under the contract.

7 1. The Owner or Owners Representative shall do the following:

8 a. Inspect all deliveries upon receipt and notify manufacturer of any issues directly.

9 b. Review the received shipment with the contractor.

10 i. Only provide products or materials to the contractor that were not damaged through
11 shipping or handling.

12 ii. Confirm missing products or materials and anticipated delivery schedule if known.

13 2. The Contractor responsible for the installation of Work associated with Owner provided materials or
14 products shall “take ownership” and provide safe and secure storage and handling as previously
15 described within this specification.

16 i. The Contractor shall be liable for the repair or replacement of any material or product
17 damaged after taking ownership of the product from receipt through final acceptance.

18 B. Section 3.8.B. shall apply to all equipment being provided by the Owner but shipped directly to any sub-
19 contractor or the project site for installation under the contract.

20 1. The GC and/or Contractor responsible for the Work associated with the Owner provided materials or
21 products shall do the following:

22 a. Inspect all deliveries upon receipt and notify the Owner or Owners Representative of any issues
23 directly.

24 i. Owner or Owners Representative shall notify manufacturer of any issues directly.

25 b. Review the received shipment with the Owner or Owners Representative

26 i. Confirm missing products or materials and anticipated delivery schedule if known.

27 2. The Contractor shall “take ownership” and provide safe and secure storage and handling as previously
28 described within this specification.

29 i. The Contractor shall be liable for the repair or replacement of any material or product
30 damaged after taking ownership of the product from receipt through final acceptance.

31
32
33 **END OF SECTION**
34
35

**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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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
28

END OF SECTION

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**SECTION 01 74 13
PROGRESS CLEANING**

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15 3.5. CALL BACK WORK 4
16

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

- 29
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

- 35
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

- 44
45
46 A. The Contractor shall provide all required personnel, equipment, and materials necessary to maintain the
47 required level of cleanliness as described in this specification.
48 B. Use only cleaning materials and equipment that are compatible with the surface being cleaned, as
49 recommended by the manufacturer, or as approved by the A/E.
50 C. Use only cleaning materials, equipment, and methods as recommended in the manufacturers care and use guide
51 of the material, finish or equipment being cleaned.
52
53

PART 3 - EXECUTION

3.1. SAFETY CLEANING

- 54
55
56 A. All Contractors shall be responsible for safety cleaning as required by OSHA and other regulatory requirements
57 as applicable.
58

- 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 f. SPECIAL NOTE FOR CONTRACT 7662 PINNEY LIBRARY – During and prior to end of each work day
5 all areas below access floor will be cleaned by Contractor per the requirements of this
6 specification. This process will continue throughout the installation of the access floor.
7 3. Weekly cleaning shall be conducted by all contractors as designated by the GC. Weekly cleanings shall
8 include all the above for a daily cleaning and other necessary cleaning as designated by the GC.
9 B. This sub-section shall apply to Progress Cleaning in preparation for the installation of finishes, fixtures, and trim.
10 a. Surfaces receiving finishes shall be thoroughly cleaned prior to contractors applying finish
11 materials. The GC shall be responsible for inspecting the area and surfaces being cleaned for
12 finish prior to the sub-contractor applying the finish. This shall include but not be limited to the
13 following:
14 i. Wall surfaces shall be wiped clean of dirt and oily residues, vacuumed free of dust, and
15 shall be free of surface imperfections prior to painting or installing wall coverings.
16 ii. Metal surfaces shall be wiped clean of dirt and oily residues, and be free of surface
17 imperfections prior to painting.
18 iii. Flooring shall be broom swept of large and loose items then vacuumed clean of dust and
19 small particles, and damp mopped clean and dried prior to installing any flooring finish.
20 Additional cleaning may be required depending on the preparation requirements
21 recommended by the flooring material manufacturer.
22 iv. SPECIAL NOTE FOR CONTRACT 7662 PINNEY LIBRARY – After the completion of all gypsum
23 wall board finishing and prior to installation of floor finishes Contractor will final clean –
24 per the requirements of this specification – all areas below the access floor. This access
25 floor cleaning is in addition to all daily and weekly cleaning required below the access
26 floor.
27 C. This sub-section shall apply to Progress Cleaning after the installation of finishes, fixtures, and trim.
28 1. For the purposes of this section “clean” shall be defined as a level of cleanliness free of dust and other
29 material capable of damaging or visually disfiguring finished work, finishes, fixtures, and trim.
30 2. Progress Cleaning at this point in the contract shall be conducted immediately as follows:
31 a. Dust, dirt, etc shall be swept and vacuumed off of finish flooring and trim.
32 b. Liquid spills shall be cleaned up according to the spill type. This shall include drips and spills
33 caused by paint, stain, sealants, and other such items.
34 3. The Contractor(s) at no additional cost to the Owner shall be responsible for replacing any finished work,
35 finishes, fixtures, and trim damaged or disfigured because of inadequate or improper cleaning.
36

37 3.4. FINAL CLEANING

- 38 A. As noted in Specification 01 29 76 Progress Payment Procedures, Progress Payment Milestone Schedule, Final
39 Cleaning shall not be conducted prior to requesting the 90% contract total progress payment and all of the
40 following shall be complete:
41 1. All final regulatory inspections including but not limited to Building Inspection Department and Madison
42 Fire Department inspections have been successfully completed.
43 2. All Quality Management Observation (QMO) reports have been closed out.
44 3. All Demonstration and Training has been completed.
45 4. All Attic Stock has been consolidated and located to its designated area
46 5. All protection for installed construction shall be removed prior to final cleaning by the contractor
47 responsible for providing the protections. This shall include the removal of any adhesive residues left
48 behind from tapes. Contractors shall only use manufacturer authorized cleaning materials for removing
49 adhesives, etc.
50 B. For the purposes of this section “clean” shall be defined as a level of cleanliness generally provided by skilled
51 cleaners using commercial quality building maintenance equipment and materials.
52 C. The GC shall be responsible for ensuring that all requirements under this section are being met.
53 D. General Requirements
54 1. Employ experienced personnel or professional cleaners for final cleaning as necessary for the areas or
55 equipment being cleaned.
56 2. Cleaning equipment used shall be commercial grade equipment commonly used by professional cleaners.

- 1 3. Cleaning equipment and materials shall be cleaned, rinsed, or replaced to ensure a uniform level of
2 cleanliness is being maintained during the final cleaning. This shall include but not be limited to the
3 following:
4 a. Vacuum cleaner bags and/or filters are changed and/or cleaned as often as necessary.
5 b. Dust & wipe down rags are washed, rinsed, or replaced before starting each room.
6 c. Mopping equipment
7 i. Mop water for washing shall have cleaning solution added to the amount and temperature
8 per manufacturer's recommendations. Mop washing water shall be replaced often to
9 maintain the levels of the cleaning solution and temperature required.
10 ii. Mop water for rinsing shall remain clean, clear, and be replaced as often as necessary.
11 iii. Mop heads shall be rinsed often and replaced as necessary.
12 iv. Mop heads and buckets shall be thoroughly rinsed with each change of water.
13 v. Only new mop heads shall be used for rinsing.
14 E. Refer to all other specifications in this contract for specific requirements regarding final cleaning of finishes,
15 fixtures, equipment, etc.
16 F. Exterior Cleaning shall include but not be limited to the following:
17 1. All exterior glazing surfaces have been professionally cleaned and are free of dust and streaking.
18 2. Metal roofs, siding, and other surfaces shall be clean of dirt and free of splashed or excess materials such
19 as sealants, mortar, paint, etc.
20 3. All exterior furnishings shall be clean, waste receptacles shall be empty.
21 4. Paved areas shall be clean, free of dirt, oily stains and other such blemishes
22 5. Exterior lights and diffusers are clean and free of dust.
23 G. Interior Cleaning shall include but not be limited to the following:
24 1. Remove all labels, stickers, tags, and other such items which are not required by code as permanent
25 labels.
26 2. All interior glazing surfaces, including mirrors, have been professionally cleaned and are free of dust and
27 streaking.
28 3. All interior surfaces have been cleaned of excess materials such as paint, sealants, etc and have been
29 wiped free of dust.
30 4. Interior metals, fixtures, and trim have been cleaned free of dust and oily residues
31 5. Carpet flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains
32 removed per manufacturers use and care instructions.
33 6. Resilient flooring has been thoroughly cleaned; vacuumed free of dust, excess glues and other stains
34 removed, mopped and buffed per manufacturers use and care instructions.
35 7. Interior non-occupied concrete floors shall be broom cleaned, vacuumed free of dust, excess glues and
36 other stains removed per manufacturers use and care instructions.
37 8. Light fixtures, lamps, diffusers and other such items have been dusted and cleaned as necessary.
38

39 **3.5. CALL BACK WORK**

- 40 A. The GC shall be responsible for ensuring that any contractor returning to the project site for completion or
41 correction work has re-cleaned and restored the area to the levels described in section 3.4 above upon
42 completion of the work. This shall include but not be limited to the following:
43 1. The immediate area(s) where work was completed.
44 2. Adjacent areas where dust or debris may have traveled.
45 3. Other areas occupied during the completion of the call back work.
46 4. Path of entrance/exit, to/from the area(s) of work.
47

48
49
50 **END OF SECTION**
51

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, guidelines, 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.

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1.3. RELATED SPECIFICATIONS

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

PART 2 - PRODUCTS

2.1. FENCING MATERIALS AND BARRICADES

- A.
 - 1. Standard orange construction barrels each with a standard rubber base ring and reflective tape
 - a. Provide flashing amber lights as needed to increase night time visibility
 - 2. Steel “T” style fence posts
 - 3. 4’0” high standard orange construction fence
 - 4. Traffic barricades
 - 5. Jersey barriers
 - 6. Other types of fencing or barricades typically used in the construction industry
- B. The contractor responsible for providing the fencing materials and barricades shall also be responsible for maintaining them. This shall include but not limited to fixing damaged fencing, standing up barrels that have been knocked over, realigning barrels, and ensuring flashing lights are fully operational at all times.
- C. The following fencing and barricade designations, and their use descriptions shall be used throughout this specification to provide uniformity in describing protection requirements.
 - 1. Type A, Jersey Barriers, to be used as permanent blocking devices to deny access to alternate project site entrances or exits.
 - 2. Type B, Traffic Barricades, to be used as temporary blocking devices to deny access to alternate project site entrances or exits.
 - 3. Type C, Construction Barrels without construction fencing shall be used for lane closures, temporary blocking devices to deny access and the protection of single locations (I.E. identify the location of an access structure) that do not require fencing.
 - 4. Type D, Construction Barrels with construction fencing where it becomes necessary to surround an object with a complete visual barricade and it is impractical or unacceptable to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected.
 - 5. Type E, Steel “T” Fence Posts shall be used at the project lines, as indicated on the Civil Drawings, with six foot galvanized chain link fencing to surround an object with a complete visual barricade and it is practical to install fence posts. The surround shall be constructed in such a manner as to provide a buffer zone around and access to the item being protected. All posts shall be driven installed. Surface mounted posts to only be used for temporary barricades.
 - 6. Type X, Other fencing or barricade types that may be designated and detailed within the construction documents shall use additional alpha numeric designations.

2.2. EROSION CONTROL PROTECTION

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

2.3. INTERIOR FINISH PROTECTION MATERIALS

- A. Except where noted in other areas of the construction documents or this specification the responsible contractor:
 - 1. Shall not provide the cheapest or least effective method as an effort to meet any protection requirement.

- 1 2. Shall provide materials of sufficient quality, and durability to provide adequate protection based on the
2 seasonal conditions and the anticipated duration at the time the protection will be needed.
3 3. Shall provide sufficient quantity of protection material to protect the construction as needed.
4 B. Prior to installing protective measures the responsible contractor shall propose to the GC, Project Architect (PA)
5 and City Project Manager (CPM) the proposed plan for protection, materials to be used and samples as
6 necessary.
7 1. The PA and CPM reserve the right to disapprove any proposed method and/or material and/or make
8 alternate proposals.
9

10 **PART 3 - EXECUTION**

11
12 **3.1. GENERAL EXECUTION REQUIREMENTS**

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

25 **3.2. PROTECT ADJACENT PROPERTIES**

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

56 **3.3. PROTECT LANDSCAPING FEATURES**

- 57 A. Except where specifically stated in other areas of the construction documents the following minimal protection
58 requirements shall apply under this section.

- 1 1. Whenever possible do not install new landscape features until exterior building construction has been
- 2 completed, equipment such as scaffolding and lifts are no longer needed and have been removed, and
- 3 heavy equipment operation is no longer required.
- 4 2. Whenever possible remove and temporarily store all existing landscape features such as benches, waste
- 5 receptacles, signage, and other such features that will be within the area of Work that can be removed.
- 6 3. Landscape features that cannot be removed such as flag poles, light poles, light bollards, etc. shall be
- 7 protected with Type D fencing for areas on pavement or Type E fencing for areas on soil.
- 8 4. Planting beds shall be protected using Type E fencing around the exposed perimeter of the planting bed
- 9 as needed.
- 10 5. The City of Madison Standard Specification 107.13 shall apply to all tree protection in and around the
- 11 project site at all times.
- 12

13 3.4. PROTECT UTILITIES

- 14 A. The contractor shall be responsible for notifying all utilities to determine emergency response procedures and
- 15 protection requirements prior to installing any construction protection.
- 16 1. This includes requesting utility marking through Diggers Hotline.
- 17 a. Call 811 or 1-800-242-8511 to request a public utility locate
- 18 b. For emergency locate call (262) 432-7910 or (877) 500-9592
- 19 2. Contact the Owner and CPM for any available private utility information on the property that may be
- 20 available prior to calling a private utility locating company.
- 21 B. Except where specifically stated in other areas of the construction documents the following minimal protection
- 22 requirements shall apply under this section.
- 23 1. Hydrants, lamp posts, electrical transformers, and other utility pedestals shall be protected with Type D
- 24 fencing for areas on pavement or Type E fencing for areas on soil. Fence posts shall be located so as to
- 25 not be directly over the utility main.
- 26 2. Storm sewer structures in pavement shall have proper inlet protection according to City of Madison
- 27 Standard Specification 210.1(g) and Type C Construction Barrels when necessary.
- 28 3. Storm sewer structures in turf and other landscaped areas shall have proper inlet protection according to
- 29 City of Madison Standard Specification 210.1(g) and Type E fencing for areas on soil.
- 30 4. Stormwater management features such as greenways, retention/detention ponds, bio-filtration ponds
- 31 and other such features shall be properly protected according to the appropriate erosion control
- 32 measure specified on the Erosion Control Plan. See multiple sections of City of Madison Standard
- 33 Specification 210.1
- 34 a. For the protection of hard to see items such as structures, castings, inlets, etc. in grassy areas
- 35 provide Type E fencing for areas on soil.
- 36 c. For the protection of storm water management features having special soils and plants such as
- 37 bio-filtration ponds provide Type E fencing for areas on soil.
- 38 5. Other structures and covers including but not limited to cleanouts, wiring hand holes, valve boxes, access
- 39 structures, grease trap structures, etc shall be protected as follows:
- 40 a. Provide Type E fencing for areas on soil.
- 41 b. When paving operations are complete provide a construction barrel or cone near structures as
- 42 necessary depending on required heavy construction traffic.
- 43

44 3.5. PROTECT PUBLIC RIGHT OF WAY

- 45 A. Except where specifically stated in other areas of the construction documents the following minimal protection
- 46 requirements shall apply under this section.
- 47 1. All public right-of-way (area from behind the sidewalk to the centerline of the street) shall remain open
- 48 and accessible except during periods of active work. At such times the public right of way shall be
- 49 properly closed and signed as referenced in City of Madison Standard Specification 107.9.
- 50 2. Bus stops and bus stop structures shall remain accessible at all times.
- 51 3. Traffic signage and traffic signals, traffic control boxes shall be protected with Type D fencing for areas on
- 52 pavement or Type E fencing for areas on soil.
- 53 a. Protection at traffic signage/signals shall not obstruct the viewing of the sign/signal for its
- 54 intended purpose at any time.
- 55 B. When additional protection for traffic control is required, the use of barricades, guardrails, lane closures and
- 56 other such procedures will be detailed within the construction documents.
- 57 C. When additional protection for overhead sidewalk cover is required the contract documents shall indicate the
- 58 specific location and structural requirements of the protective structure.

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3.6. PROTECT STORED MATERIALS

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

3.7. PROTECT WORK - EXTERIOR

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

3.8. PROTECT WORK - INTERIOR

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

- 1 C. All protection shall stay in place until the CPM, PA, and GC mutually deem the project is ready for Final Cleaning.
2 The contractors responsible for protecting the work shall be responsible for removing the protection and
3 removing any adhesive residue at that time. Contractors shall only use manufacturer authorized cleaning
4 materials for removing adhesives, etc.
- 5 D. Contractors doing work in un-protected areas of finished work shall be required to provide drop cloths and other
6 protection as noted within this specification for the duration of their work.
- 7 1. Finished areas shall be sufficiently covered to accommodate all equipment, and materials being used to
8 complete the work being done.
- 9 2. Finished areas shall be sufficiently covered to prevent splatters, over spray, etc when doing touch-up
10 work.
- 11 3. Contractors who do not provide sufficient protection under this sub-section shall be responsible for any
12 costs associated with cleaning, repairing or replacing already finished construction at no additional cost
13 to the contract.
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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.

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).

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.

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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END OF SECTION

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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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4 PART 1 – GENERAL 1
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6 1.2. RELATED SPECIFICATIONS 1
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8 1.4. O&M DATA REQUIREMENTS 1
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13 3.2. O&M DATA DRAFT SUBMITTAL 3
14 3.3. O&M DATA FINAL SUBMITTAL 3
15 3.4. CONSTRUCTION CLOSEOUT 3
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 well
21 documented and complete Operation and Maintenance (O&M) Data related to general facility use, equipment,
22 systems, finishes, and materials to City of Madison Staff (Owner, Owner Representatives, Maintenance, and
23 Custodial Personnel) as needed.
24 B. Operation and Maintenance Data shall apply to both of the following categories except where specific
25 requirements are noted under their separate titles as follows:
26 1. Operation and Maintenance Data: Generally shall mean the owner manual that provides information on
27 start-up, shut-down, operation, troubleshooting, maintenance, parts, and other such documentation as it
28 pertains to all equipment and systems installed under the Work.
29 2. Use and Care instructions: Where applicable use and care instructions shall also be considered O&M for
30 such things as flooring, tile, partitions, and other such finishes and trim related items, installed under the
31 Work.
32

1.2. RELATED SPECIFICATIONS

- 33
34 A. Section 01 29 76 Progress Payment Procedures
35 B. Section 01 31 23 Project Management Web Site
36 C. Section 01 77 00 Closeout Procedures
37 D. Section 01 78 13 Completion and Correction List
38 E. Section 01 78 19 Maintenance Contracts
39 F. Section 01 78 36 Warranties
40 G. Section 01 79 00 Demonstration and Training
41 H. Section 01 91 00 Commissioning
42 I. Other Divisions and Specifications that may address more specifically the requirements for O&M Data.
43

1.3. QUALITY ASSURANCE

- 44
45 A. All O&M Data shall meet the requirements identified in Section 1.4 below.
46 B. All contractors shall provide O&M Data for each piece of equipment, system, or finish installed during the
47 installation of the Work. O&M Data shall be provided to the General Contractor (GC) for verification and
48 submittal.
49 C. The GC shall be responsible for receiving all required O&M Data files from all contractors for verifying that all
50 files submitted meet the requirements in Section 1.4 below.
51

1.4. O&M DATA REQUIREMENTS

- 52
53 A. O&M Data shall be provided in digital PDF format as follows:
54 1. PDF files shall be complete first generation consumer useable editions of PDF documents as provided by
55 any of the following:
56 a. Product manufacturer
57 b. Supplier of product
58 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 1.5. O&M DATA SUBMITTALS

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

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

34 **PART 3 - EXECUTION**

35 3.1. O&M DATA PREPARATION - GENERAL

- 36 A. All contractors shall prepare O&M Data for draft and final submission as follows:
 - 37 1. Obtain digital PDF files for each piece of equipment, system, material or finish as described in Sections
 - 38 1.4.A.1 and 1.4.A.2 above.
 - 39 2. Verify that all information as described in Section 1.4.B above is included with the PDF file. Obtain
 - 40 missing information as necessary for a complete submittal.
- 41 B. Rename each individual PDF file as follows.
 - 42 1. Do not use special characters such as #, %, &, /, etc. These characters are reserved by the Project
 - 43 Management Web Site software the City of Madison uses; however the under-score (or under-bar) '_' is
 - 44 an allowed character.
 - 45 2. Use the following format and examples for renaming your file:
 - 46 a. Format: ***Equipment name_What_PINNEY NEIGHBORHOOD LIBRARY_Contract number_Year***
 - 47 i. *Equipment Name* represents the name of any equipment, system, material or finish as
 - 48 designated in the Contract Documents.
 - 49 ii. *What* represents what the file is about
 - 50 iii. *PINNEY NEIGHBORHOOD LIBRARY* represents the title of the project or contract. A
 - 51 shortened version of the title may be identified by the City Project Manager to be used by
 - 52 all contractors.
 - 53 iv. *Contract number* is the specific identification number the Work was bid under and appears
 - 54 on the plan set title sheet and in each sheet title block
 - 55 v. *Year* represents the year the contract will be closed out

- 1 b. Examples of file names
 2 i. AHU 2_Operation Manual_Fire Admin_1234_2015
 3 ii. CPT 2_Use and Care_MPD West_9876_2011
 4 C. All contractors shall submit the completed digital PDF files to the GC in sufficient time for the GC to meet the
 5 O&M Data submission deadlines as described in Specification Section 01 29 76, Progress Payment Procedures.
 6 D. O&M Data shall be submitted and reviewed as described in sections 3.2 and 3.3 below.
 7

8 **3.2. O&M DATA DRAFT SUBMITTAL**

- 9 A. All contractors shall prepare and submit the following for an O&M Data Draft review submittal:
 10 1. Prepare three (3) complete O&M Data file samples as described in section 3.1 above.
 11 2. Review all specifications within his/her Division of Work and prepare a complete O&M Data checklist
 12 listing all equipment, systems, materials, or finishes. Checklist shall be in tabular form similar to the
 13 example below and shall indicate the title (and plan identifier when applicable) of the O&M Data, the
 14 associated specification, and a column to verify the item has been turned in and completed.
 15 B. The GC shall be required to review all contractors' samples and checklists for compliance with this specification
 16 and shall return any to the originating contractor that are insufficient for re-submittal.
 17 1. When acceptable to the GC, he/she shall upload each O&M Data draft submittal file to the O&M Draft
 18 library on the Project Management Web Site.
 19 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
 20 O&M Data draft submittals and checklist within fifteen (15) working days as follows:
 21 1. Provide general critique comments by Division on O&M Data samples submitted. Critique is intended to
 22 provide all contractors with information on strengths and weaknesses of their submittals.
 23 a. Re-submittal of the O&M Data samples will not be required.
 24 2. Review in detail the O&M Data Checklist for completeness. Provide comments as needed.
 25 a. Re-submittal of the O&M Checklist will be required until accepted.
 26

<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	

27
 28 **3.3. O&M DATA FINAL SUBMITTAL**

- 29 A. All contractors shall prepare and submit the following for an O&M Data Final review submittal:
 30 1. Prepare complete O&M Data files as described in Section 3.1 above according to their approved checklist
 31 as described in Section 3.2 above.
 32 2. Submit completed checklist and all final O&M Data files to the GC for final submittal review.
 33 B. The GC shall be required to spot check all contractors' submittals for completeness against their checklists and
 34 for compliance with this specification and shall return any to the originating contractor that are insufficient for
 35 re-submittal.
 36 1. When acceptable to the GC, he/she shall upload each O&M Data final submittal file to the O&M Final
 37 library on the Project Management Web Site.
 38 C. The Project Architect, City Project Manager, CxA, Consulting Staffs and Owner Representatives shall review the
 39 O&M Data final submittals and checklist within fifteen (15) working days as follows:
 40 1. Review the files submitted against the checklist and request any missing files through the GC.
 41 2. Review in detail all of the O&M Data files for completeness.
 42 a. Submittals shall be accepted or rejected as individual PDF files.
 43 b. Contractors shall re-submit entire O&M submittal if any portion is rejected or incomplete.
 44

45 **3.4. CONSTRUCTION CLOSEOUT**

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

SECTION 01 78 36
WARRANTIES

1
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6 1.2. RELATED SPECIFICATIONS 1
7 1.3. DEFINITIONS 1
8 1.4. GENERAL CONTRACTORS RESPONSIBILITIES 2
9 PART 2 – PRODUCTS - THIS SECTION NOT USED 3
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11 3.1. WARRANTY CHECKLIST 3
12 3.2. LETTERS OF WARRANTY 3
13 3.3. STANDARD PRODUCT WARRANTY 4
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.

40 **1.4. GENERAL CONTRACTORS RESPONSIBILITIES**

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

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

2
3 **PART 3 - EXECUTION**

4
5 **3.1. WARRANTY CHECKLIST**

- 6 A. All contractors shall be responsible for reviewing the drawings and specifications within their Divisions of Work
7 to provide a complete and comprehensive list of all Warranty Requirements to the GC.
8 B. Each list shall indicate the title (and plan identifier when applicable) of the warranted item, the associated
9 specification of the warranted item, the terms of the warranty (years), and a column to verify the item has been
10 turned in and completed.
11 C. The GC shall be responsible for all of the following:
12 1. Consolidating all the warranty lists into one master Warranty Checklist.
13 a. The checklist shall be in a tabular data format similar to the sample below.
14 2. Upload the completed checklist to the Submittal Library on the Project Management Web Site for review.
15 See Specification 01 33 23 Submittals for more information on this procedure.
16 3. Resubmit the schedule as needed after initial reviews have been completed.
17 D. The GC shall work with all contractors to amend the Warranty Checklist throughout the execution of the project
18 based on changes and modifications as necessary.
19

<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	

20
21 **3.2. LETTERS OF WARRANTY**

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

- 1 1. The terms and conditions of the Installer Letter of Warranty shall be as defined by the
2 specifications associated with the Work but shall not be less than the industry standard of repair,
3 or replace defective materials and workmanship associated with the installation of the product
4 within one (1) year of the warranty date.
- 5 5. Special Letters of Warranty shall be required from any contractor, supplier, installer or manufacturer who
6 agrees to provide warranty services required by any Division Specification in excess of their Standard
7 Product Warranty.
8

9 **3.3. STANDARD PRODUCT WARRANTY**

- 10 A. All contractors shall be responsible for collecting and providing copies of all standard product warranties for
11 commercially available products purchased and installed under this contract.
- 12 B. Only one copy of the manufacturers' standard warranty needs to be submitted as representative for all
13 quantities of the same model number used throughout the Work.
- 14 C. Provide the manufacturers certificate, letter, or other standard documentation for each Standard Product
15 Warranty submitted as follows:
 - 16 1. Whenever possible a PDF version of the document shall be used.
 - 17 a. If a PDF version is used all additional information shall be completed using simple PDF editing
18 tools such as text boxes, highlight, etc.
 - 19 b. If a PDF version is not available and an original document is furnished the additional information
20 shall be neatly hand written and highlighted on the document in such a fashion so that it does not
21 obscure any part of the written warranty.
 - 22 2. Provide the following additional information on each warranty document:
 - 23 a. Contract warranty date.
 - 24 b. Provide the manufacturer name and model number of the product if not specified within the
25 warranty.
 - 26 i. Where the manufacturer name and model number is specified within the warranty it shall
27 be highlighted for visibility.
 - 28 c. Provide the plan identifier (LAV-1, WC-2, etc) when applicable.
- 29 D. Each completed warranty shall be saved as a digital PDF. The file shall be named using the specification number
30 and item description. I.E. 22 42 00 Toilet (WC-1).pdf
 - 31 a. Where an original certificate was furnished provide a high quality colored scan of the completed
32 document with the additional information. Save the scanned image in PDF format and use the
33 same naming convention as indicated above.
- 34 E. Provide all PDF files and any original documents to the GC for final consolidation to be provided to the Owner.
35

36 **3.4. FINAL WARRANTY SUBMITTAL**

- 37 A. The GC shall receive all required warranties (digital PDF and any original documents) from all contractors,
38 suppliers, installers and manufacturers.
- 39 B. The GC shall inventory all received warranties with the Warranty Submittal List to ensure all required warranties
40 have been received and all warranty periods are correct according to the specifications.
- 41 C. Provide with each Operation and Maintenance Manual a complete copy of any associated warranty.
- 42 D. Scan all warranties into a single organized electronic PDF file as follows:
 - 43 1. Organize the PDF file into an orderly sequence based on the table of contents of the Specifications.
 - 44 2. Provide a typed Table of Contents for the entire file at the front of the document.
 - 45 3. Provide bookmarks and links to each individual PDF to enable quick navigation through the PDF
46 document.
- 47 E. Upload the warranty submittal to the appropriate document library on the Project Management Web Site for
48 review by the PA and CPM.
- 49 F. Correct any deficiencies or omissions and resubmit as necessary.
50

51 **3.5. WARRANTY NOTIFICATION, RESPONSE, EXECUTION AND FOLLOW-UP**

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

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

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END OF SECTION

**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 **2.1. OFFICE SUPPLIES**

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

38 **PART 3 - EXECUTION**

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

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

- 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.

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.
- 58

1 **3.5. CHANGES AFTER ACCEPTANCE**

- 2 A. No Contractor shall be responsible for making changes to the As-Built record documents after acceptance by the
3 PA and CPM except when necessitated by changes resulting from any Work made by the Contractor as part of
4 his/her guarantee.
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**SECTION 01 78 43
SPARE PARTS AND EXTRA MATERIALS**

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17

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.

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**SECTION 01 79 00
DEMONSTRATION AND TRAINING**

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PART 1 – GENERAL

1.1. SUMMARY

- 19
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

1.2. RELATED SPECIFICATIONS

- 29
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

1.3. QUALITY ASSURANCE

- 41
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.

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

26
27 **3.6. CLOSEOUT PROCEDURE**

- 28 A. Prior to receiving the 90% Progress payment the GC shall:
- 29 1. Verify with the PA and CPM that each Demonstration and Training Session was conducted properly and
- 30 according to the submitted plan.
- 31 2. Any required "Off Season" equipment testing, balancing, and Demonstration and Training Sessions have
- 32 been tentatively scheduled with the GC, necessary sub-contractors, instructors and Owner/Owner
- 33 Representatives as necessary.
- 34
- 35

36 **END OF SECTION**

37

SECTION 01 81 13
SUSTAINABLE DESIGN REQUIREMENTS – LEED FOR COMMERCIAL INTERIORS V3

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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.
- B. Comply with Wisconsin Commercial Building Codes/International Building Code (IBC).
- C. Comply with Americans with Disabilities Architectural Guidelines, and ICC/ANSI A117.1-Latest Edition.
- D. Comply with USGBC LEED prerequisites and credits needed for Project to obtain "LEED Gold certification based on USGBC's LEED 2009 for Commercial Interiors".

1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain "LEED Gold certification based on USGBC's LEED-CI (Commercial Interiors)" Version 3.0.
 - 1. Other LEED prerequisites and credits needed to obtain LEED certification depend on product selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
 - 2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.
 - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
 - 4. Specific requirements for LEED are included in greater detail in other Sections.
- B. Related Sections: Divisions 01 through 32 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

- A. Albedo (a.k.a. solar reflectance): The ratio of the reflected electromagnetic energy to the incoming electromagnetic energy.

- 1 B. Chain-of-Custody Certificates: Certificates signed by manufacturers certifying that wood used to make products
2 was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC
3 Principles and Criteria for Forest Stewardship." Certificates shall include evidence that manufacturer is certified
4 for chain of custody by an FSC-accredited certification body.
- 5 C. Emissivity (a.k.a. infrared emittance): A parameter between 0 and 1 that indicates the ability of a material to
6 shed infrared radiation.
- 7 D. LEED: Leadership in Energy and Environmental Design. Green Building Rating System representing the US Green
8 Building Council's effort to provide a national standard for what constitutes a "green building". The standard
9 requires quantitative and technical documentation to demonstrate compliance with goals described in the US
10 Green Building Council's Green Building Rating System, Version 3.0.
- 11 E. Hydrofluorocarbons (HFCs): Refrigerants used in building equipment that do not deplete the stratospheric ozone
12 layer.
- 13 F. Locally-Manufactured (for LEED™ Materials Credit 5): Refers to the final assembly of components into the
14 building product that is furnished and installed by the trades people. For example, if the hardware comes from
15 Seoul, South Korea, the lumber from Vancouver, British Columbia, and the joist is assembled in Kent
16 Washington, then the location of the final assembly is Kent, Washington.
- 17 G. Post-Consumer Recycled Content: The percentage of waste material by weight available from consumer use
18 incorporated into a building material.
- 19 H. Pre-consumer (aka Post-Industrial Recycled) Content: The percentage of waste material by weight available from
20 industrial use incorporated into a building material. Post-industrial recyclable materials are different from
21 industrial scrap, a by-product of industrial processes that can easily be reused as a feedstock.
- 22 I. Potable Water: Water that is suitable for drinking and is supplied from wells or municipal water systems.
- 23 J. Recycling: The collection, reprocessing, marketing and use of materials that were recovered or diverted from the
24 solid waste stream. Note that LEED uses the term "pre-consumer" rather than "post-industrial." Also note that
25 when manufacturers and trade associations use the term "post-industrial" it often includes spills, scraps, and
26 damaged and surplus materials that are fed back into the same manufacturing process and that these materials
27 are not considered recycled content by the LEED rating systems.
- 28 K. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The
29 recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content
30 value.
- 31 L. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial,
32 and institutional facilities in their role as end users of the product, which can no longer be used for its intended
33 purpose.
- 34 M. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing
35 process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and
36 capable of being reclaimed within the same process that generated it.
- 37 N. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within
38 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and
39 manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
- 40 O. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project
41 site. Manufacturing refers to the final assembly of components into the building product that is installed at
42 Project site.
- 43 P. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials
44 that are extracted, harvested, or recovered within a radius of 500 miles from Project site.
- 45 Q. Solar Reflectance: See "Albedo."
- 46 R. Sustainable Forestry: The practice of managing forest resources to meet the long-term product needs of humans
47 while maintaining the biodiversity of forested landscapes. The primary goal is to restore, enhance, and sustain a
48 full range of forest values, both economic and ecological.
- 49 S. Type A Finishes: Material and finishes with potential for short-term levels of off gassing from chemicals inherent
50 in their manufacturing process, or which are applied in form requiring vehicles or carriers for spreading which
51 release high level of particulate matter in process of installation and/or curing. Including, but not limited to:
- 52 1. Composite wood products, specifically including particleboard from which millwork, wood paneling,
53 doors, or furniture may be fabricated.
- 54 2. Adhesives, sealants, and glazing compounds, specifically those with petrochemical vehicles or carriers.
- 55 3. Wood preservatives, finishes, and paint.
- 56 4. Control and/or expansion joint-fillers.
- 57 5. Hard finishes requiring adhesive installation.
- 58 6. Gypsum board and associated finish processes.

- 1 T. Type B Finishes: Fuzzy material and finishes which are woven, fibrous, or porous in nature and tend to adsorb
2 chemicals off-gassed by Type A finishes or may be adversely affected by particulates. These materials become
3 "sink" for deleterious substances which may be released much later, or collectors of contaminants that may
4 promote subsequent bacterial growth. Including, but not limited to:
5 1. Carpeting and padding.
6 2. Fabric wallcovering.
7 3. Insulation exposed to air stream.
8 4. Acoustic ceiling materials.
9 5. Fabric covered acoustic wall panels.
10 6. Upholstered furnishings.
11 7. Materials that can be categorized as both Type A and Type B.
- 12 U. Ventilation: The process of supplying and removing air to and from interior spaces by natural or mechanical
13 means.
- 14 V. Volatile organic compounds (VOCs): Chemical compounds based on carbon and hydrogen structures that are
15 vaporized at room temperatures. VOCs are one type of indoor air contaminant.
- 16 W. Waste Materials: Large and small pieces of materials indicated which are excess to contract requirements and
17 generally include materials salvaged from existing construction and items of trimmings, cuttings, and damaged
18 goods resulting from new installations which cannot be effectively used in Work.
- 19 X. LEED Project Administrator: LEED Certified Professional hired by the project owner to review LEED submittals.
20

21 1.4 ADMINISTRATIVE REQUIREMENTS

- 22 A. Respond to questions and requests from Architect and the USGBC regarding LEED credits that are the
23 responsibility of the Contractor, that depend on product selection or product qualities, or that depend on
24 Contractor's procedures until the USGBC has made its determination on the project's LEED certification
25 application. Document responses as informational submittals.
26

27 1.5 ACTION SUBMITTALS

- 28 A. General: Submit additional LEED submittals required by other Specification Sections.
- 29 B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply
30 with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated
31 LEED requirements.
- 32 C. LEED Submittals: Submit LEED related information under a separate Tab within each product submittal. The LEED
33 submittal shall include:
 - 34 1. Summary Sheet: A summary, on General Contractors letterhead, of all LEED information requested in
35 specifications shall include:
 - 36 a. PINNEY LIBRARY.
 - 37 b. LEED Submittal List: A list of all materials being submitted. For products composed of multiple
38 materials the submittal shall include a list of all materials composing the product.
 - 39 c. For Products in Divisions 2 - 10, include the following information:
 - 40 i. Material costs, for each material on the LEED submittal list, excluding labor costs, delivery
41 cost, cost of installation, as well as profit and overhead.
 - 42 ii. The preconsumer and post-consumer recycled content of each material on the LEED
43 submittal list.
 - 44 iii. List of all material manufacturing locations.
 - 45 iv. Provide distance between manufacturing and construction site.
 - 46 d. All other LEED information required in specification.
 - 47 2. Manufacturer's literature with information highlighted that confirm the figures used in the summary
48 report.
 - 49 a. If a range is used in the manufacturer's literature, the summary report shall use the lowest
50 number in the range.
 - 51 b. For VOC Submissions: Submit MSDS sheets or manufacturer's literature with VOC figure
52 highlighted.
- 53 D. Project Material Costs Data: Provide a statement, on Contractor's letterhead, documenting the total material for
54 the project. Include a spreadsheet tallying the material cost for all materials specified in Divisions 2 - 32. The
55 total in the material cost data will be used in the LEED Online template to be completed by the Contractor as the
56 actual material cost of the project.
- 57 E. LEED Action Plan: Provide preliminary submittal within 30 days of Notice to Proceed that contains:
 - 58 1. Example spreadsheets for each construction credit identified in this section.

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2. Contact information for Contractor's LEED coordinators.
 3. Brief description of how the following requirements will be met.
 - a. Credit MR c2: Construction Waste Management complying with Section 01 74 19 Construction Waste Management and Disposal. Include a sample spreadsheet showing how the tipping information is going to be recorded to comply with LEED requirements.
 - b. Credit MR c4: Recycled content information including methods of collection and recording.
 - c. Credit MR c5: Manufacturing location information including methods of collection and recording.
 - d. Credit MR c6: Rapidly renewable materials information including methods of collection recording.
 - e. Credit MR c7: Certified wood product incorporated into the construction of the facility and a description of how certified wood information, including the chain-of-custody letters are going to be collected and recorded.
 - f. EQ c4.1 – 4.5: VOC information including methods of collection and recording required LEED information.
 4. After CPM approval of the Preliminary Action Plan the Contractor shall update the plan monthly with LEED information collected to date and be submitted as part of a monthly progress report.
- F. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing the actual construction and purchasing activities with LEED requirements for the following:
1. Credit MR c2: Construction Waste Management.
 2. Credit MR c4: Recycled content for materials specified in Divisions 2 - 32.
 3. Credit MR c5 Regional Materials: Distance to manufacturing for materials specified in Divisions 2 - 32.
 4. Credit MR c7: Certified wood products including the chain-of-custody letters identifying the forest of origin.
 5. IEQ c4.1 – 4.5: VOC information.
- G. LEED Documentation Online Submittals: The Contractor shall be responsible for completing the following LEED submissions using the LEED online tool for credit submission to USGBC. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.
1. Credit EA 3: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over a period of time of not less than one year of post-construction occupancy.
 2. Credit MR 2: Comply with Division 1 Section "Construction Waste Management and Disposal."
 3. Credit MR 4: Product data and certification letter from product manufacturers indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating material costs for each product having recycled content.
 4. Credit MR 5: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
 5. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
 6. Credit IEQ 3.1:
 1. Construction indoor-air-quality management plan.
 2. Product data for temporary filtration media.
 3. Product data for filtration media used during occupancy.
 4. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
 7. Credit IEQ 3.2: Construction IAQ Plan: Before Occupancy.
 1. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
 2. Report from testing and inspecting agency indicating results of indoor-air- quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
 8. Credit IEQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subject D (EPA Method 24).
 9. Credit IEQ 4.2: Product data for paints and coatings used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subject D (EPA Method 24).

1 **1.6 INFORMATIONAL SUBMITTALS**

- 2 A. Qualification Data: For LEED coordinator.
- 3 B. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude
4 labor, overhead, and profit. Include breakout of costs for the following categories of items:
- 5 1. Furniture.
- 6 2. Plumbing.
- 7 3. Mechanical.
- 8 4. Electrical.
- 9 5. Specialty items such as elevators and equipment.
- 10 6. Wood-based construction materials.
- 11 C. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice of Award
12 indicating how the following requirements will be met:
- 13 1. Credit MR 2: Waste management plan complying with Section 01 74 19 "Construction Waste
14 Management and Disposal."
- 15 2. Credit MR 4: List of proposed materials with recycled content. Indicate cost, post- consumer recycled
16 content, and pre-consumer recycled content for each product having recycled content.
- 17 3. Credit MR 5: List of proposed regional materials. Identify each regional material, including its source,
18 cost, and the fraction by weight that is considered regional.
- 19 4. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood,
20 including its source and cost of certified wood products.
- 21 5. Credit IEQ 3.1: Construction indoor-air-quality management plan.
- 22 D. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual
23 construction and purchasing activities with LEED action plans for the following:
- 24 1. Credit MR 2: Waste reduction progress reports complying with Section 01 74 19 "Construction Waste
25 Management and Disposal."
- 26 2. Credit MR 4: Recycled content.
- 27 3. Credit MR 5: Regional materials.
- 28 4. Credit MR 7: Certified wood products.
- 29

30 **1.7 QUALITY ASSURANCE**

- 31 A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED
32 coordinator may also serve as waste management coordinator.
- 33

34 **1.8 CONTRACTOR RESPONSIBILITIES**

- 35 A. This project has been registered with USGBC. The Contractor shall provide all necessary documentation for LEED
36 v3.0 certification in accordance with the specifications. Format and content of all construction documentation
37 must be in accordance with the LEED Reference Guide requirements for supporting data required in event of
38 USGBC audit of the particular credit. Contractor is required to coordinate all requirements to assure assembled
39 data is acceptable to USGBC and respond to USGBC requests for additional construction data in the course of
40 preparing the project for certification.
- 41

42 **PART 2 – PRODUCTS**

43

44 **2.1 MATERIALS, GENERAL**

- 45 A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other
46 Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine
47 additional materials and procedures necessary to obtain LEED credits indicated.
- 48

49 **2.2 RECYCLED CONTENT OF MATERIALS**

- 50 A. Credit MR 4.1: Building materials shall have recycled content such that post-consumer recycled content plus one-
51 half of pre-consumer recycled content constitutes a minimum of [10] percent of cost of materials used for
52 Project.
- 53 1. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall
54 be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer
55 recycled content in the item by total weight of the item and multiplying by cost of the item.
- 56 2. Cost of post-consumer recycled content plus one-half of pre-consumer recycled content of an item shall
57 be determined by dividing weight of post-consumer recycled content plus one-half of pre-consumer
58 recycled content in the item by total weight of the item and multiplying by cost of the item.

- 1 3. Do not include plumbing, mechanical and electrical components, and specialty items such as elevators
2 and equipment in the calculation.
3
- 4 **2.3 REGIONAL MATERIALS**
- 5 A. Credit MR 5: Provide a minimum of 10 percent of building materials (by cost) that are regional materials.
6
- 7 **2.4 RAPIDLY RENEWABLE MATERIALS**
- 8 A. NOT USED
9
- 10 **2.5 CERTIFIED WOOD**
- 11 A. Credit MR 7: Not less than 50 percent (by cost) of wood-based materials that are produced from wood obtained
12 from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and
13 Criteria for Forest Stewardship."
14 1. Wood-based materials include, but are not limited to, the following materials when made from wood,
15 engineered wood products, or wood-based panel products:
16 a. Rough carpentry.
17 b. Miscellaneous carpentry.
18 c. Finish carpentry.
19 d. Architectural woodwork.
20
- 21 **2.6 LOW-EMITTING MATERIALS**
- 22 A. Credit IEQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants shall
23 comply with the following limits for VOC content limits when calculated according to 40 CFR 59, Subpart D (EPA
24 Method 24):
25 1. Wood Glues: 30 g/L.
26 2. Metal to Metal Adhesives: 30 g/L.
27 3. Adhesives for Porous Materials (Except Wood): 50 g/L.
28 4. Plastic Foam Adhesives: 50 g/L.
29 5. Carpet Adhesives: 50 g/L.
30 6. Carpet Pad Adhesives: 50 g/L.
31 7. VCT and Asphalt Tile Adhesives: 50 g/L.
32 8. Cove Base Adhesives: 50 g/L.
33 9. Gypsum Board and Panel Adhesives: 50 g/L.
34 10. Rubber Floor Adhesives: 60 g/L.
35 11. Ceramic Tile Adhesives: 65 g/L.
36 12. Multipurpose Construction Adhesives: 70 g/L.
37 13. Contact Adhesive: 80 g/L.
38 14. Structural Wood Member Adhesive: 140 g/L.
39 15. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered
40 board, metal, unsupported vinyl, rubber or wood veneer 1/16 inch or less in thickness to any
41 surface): 250 g/L.
42 16. Top and Trim Adhesive: 250 g/L.
43 17. ABS Welding Compounds: 325 g/L.
44 18. CPVC Welding Compounds: 490 g/L.
45 19. PVC Welding Compounds: 510 g/L.
46 20. Adhesive Primer for Plastic: 550 g/L.
47 21. Plastic Cement Welding Compounds: 350 g/L.
48 22. ABS Welding Compounds: 400 g/L.
49 23. CPVC Welding Compounds: 490 g/L.
50 24. PVC Welding Compounds: 510 g/L.
51 25. Adhesive Primer for Plastic: 650 g/L.
52 26. Sheet Applied Rubber Lining Adhesive: 850 g/L.
53 27. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
54 28. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
55 29. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
56 30. Other Adhesives: 250 g/L.

- 1 31. Architectural Sealants: 250g/L.
- 2 32. Non-membrane Roof Sealants: 300 g/L.
- 3 33. Single-Ply Roof Membrane Sealants: 450g/L.
- 4 34. Other Sealants: 420 g/L.
- 5 35. Sealant Primers for Nonporous Substrates: 250g/L.
- 6 36. Sealant Primers for Porous Substrates: 775g/L.
- 7 37. Modified Bituminous Sealant Primers: 500g/L.
- 8 38. Other Sealant Primers: 750 g/L.
- 9 B. Credit IEQ 4.2: For field applications that are inside the weatherproofing system, paints and coatings shall comply
- 10 with the following VOC content limits when calculated according to 40 CFR 59 (EPA method 24):
- 11 1. Flat Paints and Coatings: VOC not more than 50g/L.
- 12 2. Nonflat Paints and Coatings: VOC not more than 150g/L.
- 13 3. Dry-Fog Coatings: VOC not more than 400 g/L.
- 14 4. Primers, Sealers, and Undercoaters: VOC not more than 200g/L.
- 15 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
- 16 6. Zinc-Rich Industrial Maintenance Primers: VOC not more than 340 g/L.
- 17 7. Pretreatment Wash Primers: VOC not more than 420g/L.
- 18 8. Clear Wood Finishes, Varnishes: VOC not more than 350g/L.
- 19 9. Clear Wood Finishes, Lacquers: VOC not more than 550g/L.
- 20 10. Floor Coatings: VOC not more than 100g/L.
- 21 11. Shellacs, Clear: VOC not more than 730g/L.
- 22 12. Shellacs, Pigmented: VOC not more than 550g/L.
- 23 13. Stains: VOC not more than 250g/L.
- 24 C. Credit IEQc4.3: All flooring must comply with the following as applicable to the project scope:
- 25 1. All carpet and carpet cushion must meet the requirements of the Carpet and Rug Institute
- 26 Green LabelProgram.
- 27 2. All carpet adhesive must have VOC limit of 50 g/L.
- 28 3. All hard surface flooring must meet the requirements of the FloorScore Standard.
- 29 4. Concrete, wood, bamboo and cork floor finishes and tile setting adhesives must meet the
- 30 requirements of South Coast Air Quality Management District (SCAQMD) Rules 1113 and
- 31 1168.
- 32
- 33

PART 3 – EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

- 37 A. Credit MRC2: Comply with Division 1 Section “Construction Waste Management and Disposal”.
- 38 1. Contractor is responsible for completing the LEED online credit template. Attached documentation in
- 39 support of the credit shall include:
- 40 a. Monthly photographs of waste recycling sorting area including:
- 41 i. Debris control fencing.
- 42 ii. Signage clearly identifying the containers content.
- 43 b. Spreadsheet containing the following information:
- 44 i. Diverted materials description.
- 45 ii. Diverted materials/waste hauler name.
- 46 iii. Date of each haul.
- 47 iv. Quantity of material in each haul.
- 48 c. Copies of recycling vender and waste hauler tipping receipts.
- 49 2. The LEED Project Administrator will determine if the information prepared by the Contractor is
- 50 satisfactory for USGBC submission.

3.2 RECYCLED CONTENT OF BUILDING MATERIALS

- 52 A. Credit MRC4: Recycled Content:
- 53 1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
- 54 2. Provide record showing the preconsumer and post-consumer recycled content of all materials specified in
- 55 Divisions 2 - 32.

3. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
 - a. Spreadsheet containing the following information:
 - i. The description of each materials in each product specified in Divisions 2 - 32.
 - ii. Material manufacturer's name.
 - iii. Material cost.
 - iv. Percent preconsumer recycled content of each material.
 - v. Percent post-consumer recycled content of each material.
 - vi. Recycled content information source.
 - b. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the spreadsheet.
4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.3 REGIONAL MATERIALS

- A. Credit MRC5: Regional Materials:
 1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
 2. Provide record showing the manufacturing location for all materials specified in Divisions 2 - 32.
 3. Contractor is responsible for completing the LEED online credit application and attaching the following information to the application:
 - a. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the spreadsheet.
 4. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.4 CERTIFIED WOOD

- A. Credit MRC7 Certified Wood:
 1. Follow LEED instructions in LEED NCv3.0 Reference Guide to comply with Credit MRC7 requirements for certified wood installed in construction.
 2. Contractor is responsible for completing the LEED online credit template and attaching the following information to the template:
 - a. Copies of vendors literatures or a statement from vendors on vendor's letterhead confirming the figures used in the LEED Online Certified Wood Materials Calculator spreadsheet.
 - b. Copies of the chain-of-custody documentation received from vendors on vendors.
 3. The LEED Project Administrator will determine if the information prepared by the Contractor is satisfactory for USGBC submission.

3.5 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Credit IEQc3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
 1. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 1 Section "Temporary Facilities and Controls", install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
 2. Replace all air filters immediately prior to occupancy.
 3. Provide record of compliance with Indoor Air Quality Management Plan:
 - a. Monthly photographs of equipment and ductwork protection.
 - b. Monthly photographs of filters used to protect air distribution and equipment.
 - c. Contractor's report documenting that MERV 8 filters were used to protect equipment during construction and MERV 13 filters were installed prior to occupancy.
- B. Credit IEQc3.2: Indoor Air Quality management Plan – Before Occupancy:
 1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
 2. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside air rate determined in IEQ Prerequisite 1, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three (3) hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14000 cu. ft./sq. ft. of outside air has been delivered to the space.

- 1 3. Air-Quality Testing: If the Contractor chooses to test for compliance with LEED Credit IEQc3.2 the
2 following is required:
3 a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using
4 testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air
5 Pollutants in Indoor Air," and as additionally detailed in the USGBC's "Green Building Design and
6 Construction Reference Guide".
7 b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
8 i. Formaldehyde: 27 ppb.
9 ii. Particulates (PM10): 50 micrograms/cu. m.
10 iii. Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
11 iv. 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
12 v. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
13
14 c. For each sampling point where the maximum concentration limits are exceeded, conduct
15 additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the
16 requirements are achieved. Repeat procedure until all requirements have been met. When
17 retesting non-complying building areas, samples are to be taken from the same locations as the
18 first test.
19 d. Air-sample testing shall be conducted as follows:
20 i. All measurements shall be conducted prior to occupancy but during normal occupied
21 hours and with building ventilation system starting at the normal daily start time and
22 operated at the minimum outside air flow rate for the occupied mode throughout the
23 duration of the air testing.
24 ii. Building shall have all interior finishes installed including, but not limited to, millwork,
25 doors, paint, carpet, and acoustic tiles. Non-fixed furnishings such as workstations and
26 partitions are encouraged, but not required to be in place for the testing.
27 iii. Number of sampling locations will vary depending on the size of building and number of
28 ventilation systems. For each portion of building served by a separate ventilation system,
29 the number of sampling points shall not be less than one per 25,000 sq. ft. or for each
30 contiguous floor area, whichever is larger, and shall include areas with the least ventilation
31 and greatest presumed source strength.
32 iv. Air samples shall be collected between 3 and 6 feet from the floor to represent the
33 breathing zone of occupants, and over a minimum four- hour period.
34 4. The LEED Project Administrator will determine if the information prepared by the Contractor is
35 satisfactory for USGBC submission.

36 **3.6 LOW EMITTING MATERIALS**

- 37 A. Credit IEQc4.1 through Credit MRc4.4: Low Emitting Materials:
38 1. Follow LEED instructions in LEED NCv3.0 Reference Guide.
39 2. Contractor is responsible for completing the LEED online credit template and attaching the following
40 information to the template:
41 a. Copies of vendor's literature or MSDS sheets confirming the figures used in the spreadsheet.
42 3. The LEED Project Administrator will determine if the information prepared by the Contractor is
43 satisfactory for USGBC submission.
44

45 **3.7 INDOOR CHEMICAL AND POLLUTANT SOURCE CONTROL**

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

48 **3.8 SUPPLEMENT**

- 49 A. The supplement listed below, following "End of Section," is a part of this Specification:
50 1. LEED for Commercial Interiors v3.0 Registered Project Checklist.
51
52
53

END OF SECTION



LEED 2009 for Commercial Interiors
 Project Checklist

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Y	?	N
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Sustainable Sites Possible Points: 21

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d	Credit 1	Site Selection	1 to 5
		<input type="checkbox"/> Option 1: Select a LEED Certified Building	5
		OR	
		<input type="checkbox"/> Path 1: Brownfield Redevelopment	1
		<input type="checkbox"/> Path 2: Stormwater Design—Quantity Control	1
		<input type="checkbox"/> Path 3: Stormwater Design—Quality Control	1
		<input type="checkbox"/> Path 4: Heat Island Effect—Nonroof	1
		<input type="checkbox"/> Path 5: Heat-Island Effect—Roof	1
		<input type="checkbox"/> Path 6: Light Pollution Reduction	1
		<input type="checkbox"/> Path 7: Water Efficient Landscaping—Reduce by 50%	2
		<input type="checkbox"/> Path 8: Water Efficient Landscaping—No Potable Water Use or Irrigation	2
		<input type="checkbox"/> Path 9: Innovative Wastewater Technologies	2
		<input type="checkbox"/> Path 10: Water Use Reduction—30% Reduction	1
		<input type="checkbox"/> Path 11: On-site Renewable Energy	2
		<input type="checkbox"/> Path 12: Other Quantifiable Environmental Performance	1
d	Credit 2	Development Density and Community Connectivity	6
d	Credit 3.1	Alternative Transportation—Public Transportation Access	6
d	Credit 3.2	Alternative Transportation—Bicycle Storage and Changing Rooms	2
d	Credit 3.3	Alternative Transportation—Parking Availability	2

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Y	?	N
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Water Efficiency Possible Points: 11

d	Prereq 1	Water Use Reduction—20% Reduction	
d	Credit 1	Water Use Reduction	6 to 11

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Energy and Atmosphere

Possible Points: **37**

Y ? N

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- C Prereq 1 Fundamental Commissioning of Building Energy Systems
- d Prereq 2 Minimum Energy Performance
- d Prereq 3 Fundamental Refrigerant Management

- d Credit 1.1 Optimize Energy Performance—Lighting Power 1 to 5

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 - 15% Reduction 1
 - 20% Reduction 2
 - 25% Reduction 3
 - 30% Reduction 4
 - 35% Reduction 5

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- d Credit 1.2 Optimize Energy Performance—Lighting Controls 1 to 3

1

 - Daylight Controls for Daylit Areas 1
 - Daylight Controls for 50% of the Lighting Load 1
 - Occupancy Sensors for 75% of the Connected Lighting Load 1

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- d Credit 1.3 Optimize Energy Performance—HVAC 5 to 10

5
5

 - Equipment Efficiency 5
 - Zoning Controls 5

OR

 - Reduce Design Energy Cost and 15% Improvement 5
 - Reduce Design Energy Cost and 30% Improvement 10

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- d Credit 1.4 Optimize Energy Performance—Equipment and Appliances 1 to 4

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 - 70% ENERGY STAR 1
 - 77% ENERGY STAR 2
 - 84% ENERGY STAR 3
 - 90% ENERGY STAR 4

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- C Credit 2 Enhanced Commissioning 5
- d Credit 3 Measurement and Verification 2 to 5

 - Install Sub-Metering Equipment 2
 - Tenant Pays for Energy 3

OR

5

 - Metering, Measurement and Payment Accountability 5

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- d Credit 4 Green Power 5

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5 0 9			Materials and Resources		Possible Points: 14
Y	?	N			
Y			d Prereq 1	Storage and Collection of Recyclables	
1			d Credit 1.1	Tenant Space—Long-Term Commitment	1
		2	d Credit 1.2	Building Reuse	1 to 2
				40% Reuse	1
				60% Reuse	2
1		1	c Credit 2	Construction Waste Management	1 to 2
				1 Divert 50% from Disposal	1
				Divert 75% from Disposal	2
		2	c Credit 3.1	Materials Reuse	1 to 2
				5% Reuse	1
				10% Reuse	2
		1	c Credit 3.2	Materials Reuse—Furniture and Furnishings	1
1		1	c Credit 4	Recycled Content	1 to 2
				1 10% of Content	1
				20% of Content	2
1		1	c Credit 5	Regional Materials	1 to 2
				1 20% of Materials Manufactured	1
				20% of Materials Manufactured and 10% Extracted	2
		1	c Credit 6	Rapidly Renewable Materials	1
1			c Credit 7	Certified Wood	1

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Indoor Environmental Quality

Possible Points: 17

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d Prereq 1	Minimum IAQ 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
C Credit 4.5	Low-Emitting Materials—Systems Furniture and Seating	1
d Credit 5	Indoor Chemical & 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 to 2
	1 75% of Spaces	1
	90% of Spaces	2
d Credit 8.2	Daylight and Views—Views for Seated Spaces	1

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Innovation and Design Process

Possible Points: 6

Y	?	N
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d/C Credit 1.1	Optimize Energy Performance—Lighting Power	1
d/C Credit 1.2	Innovation in Design: Green Cleaning	1
d/C Credit 1.3	Innovation in Design: Lighting Mercury Reduction	1
d/C Credit 1.4	Innovation in Design: Development Density	1
d/C Credit 1.5	Innovation in Design: Specific Title	1
d Credit 2	LEED Accredited Professional	1

3 0 1

Regional Priority Credits

Possible Points: 4

Y	?	N
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1		
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		1

d/C Credit 1.1	Site Selection	1
d/C Credit 1.2	Development Density and Community Connectivity	1
d/C Credit 1.3	Alternative Transportation—Public Transportation Access	1
d/C Credit 1.4	Regional Priority: Specific Credit	1

79 0 29

Total

Possible Points: 110

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

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**SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS**

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PART 1 – GENERAL

1.01. RELATED DOCUMENTS

- A. Owner Program Requirements and Basis of Design

1.02. GENERAL DESCRIPTION

- A. Commissioning is the process of verifying and validating that all building systems are installed and perform interactively according to the design intent; that systems are efficient and cost effective to operate and meet the Owner's operational needs; that the installation is adequately documented; and that Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.
- B. Commissioning Provider shall work with the Contractor and the Engineer to direct and oversee the Commissioning process.
 - 1. Utilize Autodesk BIM-360 collaboration software to maintain an observation log, equipment installation and start-up status.
 - 2. Contractors and subcontractors shall interface with the Cx process using BIM-360 web interface and/or an Apple iPad.
 - 3. Generate a commissioning plan including schedule.
 - 4. Integrate commissioning activities into the general construction schedule.
 - 5. Provide commissioning specifications
 - 6. Lead commissioning kick-off and coordination meetings.
 - 7. Verify that applicable equipment and systems are installed according to the contract documents, manufacturer's recommendation, and industry accepted minimum standards and that they receive adequate operational checkout by the installing contractors.
 - 8. Verify and document test, adjust and balance is complete and accurate.
 - 9. Verify and document proper performance of equipment and systems.

- 1 10. Verify that operation and maintenance documentation left onsite is complete.
 2 11. Verify that the owner's operating personnel are adequately trained.
 3 12. Provide a Final Commissioning report.
 4 C. The Commissioning Plan details the commissioning process.
 5 D. The Commissioning process does not take away from or reduce the responsibility of the system designers or
 6 installing contractors to provide a finished and fully functional product as defined in the plans and specifications.
 7 E. This Section and other Sections of the specifications detail the Contractor's responsibilities relative to the
 8 Commissioning process. It expands on the Commissioning Plan, which covers the roles and responsibilities of all
 9 Parties. It also indicates the details of the Functional Performance Testing in which the Contractor must
 10 participate.
 11

12 1.03. SUMMARY

- 13 A. Section includes:
 14 1. General requirements that apply to implementation of commissioning without regard to specific systems,
 15 assemblies, or components.
 16 B. Specific Equipment/systems to be utilized is "to be determined" (TBD) at this time. At minimum, the following
 17 general equipment/systems shall be commissioned:
 18 1. HVAC system and controls.
 19 2. Lighting control system.
 20 3. Domestic hot water system.
 21 4. Metering.
 22 C. References:
 23 1. ASHRAE Standard 202-2013, "The Commissioning Process for Building and Systems"
 24 2. ASHRAE Guideline 0-2013, "The Commissioning Process"
 25 3. ASHRAE Guideline 1.1-2007, "HVAC & R Technical Requirements for the Commissioning Process"
 26 4. ASHRAE Guideline 4-2008, "Preparation of Operating and Maintenance Documentation for HVAC&R
 27 Systems"
 28 5. American Society for Testing and Materials (ASTM)
 29 6. BCA - Building Commissioning Association
 30 7. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)
 31 8. International Building Code (IBC)
 32 9. Illuminating Engineering Society (IES)
 33 10. Institute of Electrical and Electronics Engineers (IEEE)
 34 11. International Electrical Testing Association (NETA)
 35 12. National Electrical Manufacturers Associates (NEMA)
 36 13. National Fire Protection Association (NFPA)
 37 14. NEBB - Procedural Standards for Building Systems Commissioning
 38 15. National Electric Code (NEC)
 39 16. NETA-ATS, Testing Standards
 40 17. Underwriters Laboratory, Inc. (UL)
 41 18. U.S. Green Building Council (USGBC)
 42 19. Washington State Energy Code (WSEC)
 43 20. Washington Sustainable Schools Protocol (WSSP) Fundamental Commissioning
 44 21. WSSP Enhanced Commissioning
 45 D. Related Sections:
 46 1. Section 23 05 93 "Testing, Adjusting and Balancing".
 47 2. Section 23 09 00 "Controls "
 48

49 1.04. DEFINITIONS

- 50 1. Acceptance Phase: This is the phase of the project when the facility and its systems and equipment are
 51 inspected, tested, verified, and documented; and when most of the Functional Performance Testing and
 52 formal training occurs. This will generally occur after the Construction Phase is complete (start-up and
 53 checks have been accomplished). The Acceptance Phase typically begins with Substantial Completion
 54 and ends with Functional Completion.
 55 2. A/E: General reference to the Architect/Engineer lead-design entity.
 56 3. Building Automation System (BAS): The computer-based heating, ventilation and air-conditioning (HVAC)
 57 control or automation system.

- 1 4. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections
2 used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The
3 document includes both narrative descriptions and lists of individual items that support the design
4 process.
- 5 5. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and
6 documentation requirements of the commissioning process.
- 7 6. Commissioning Authority (CA): The Party retained by the Owner who will oversee the Commissioning
8 process as well as develop and stipulate many of the Commissioning requirements. They will also
9 manage the Commissioning process, and ensure and validate that systems and equipment are designed,
10 installed and tested to meet the Owner's requirements.
- 11 7. Commissioning Coordinator (CxC): This refers to the Individual within each of the various Parties that is
12 designated the point of contact for that Party relative to Commissioning activities.
- 13 8. Commissioning Portal: This is an internet hub for the collaboration on Commissioning information. This
14 portal will act as a hub for posting electronic information.
- 15 9. Commissioning Plan: The Commissioning Plan is a part of the Contract Documents and outlines many of
16 responsibilities, procedures and tasks throughout the Commissioning process. It also describes the
17 Functional Performance Tests that will be performed during the Acceptance Phase. The Contractor must
18 have an understanding of commissioning process and the Contractor requirements within the plan.
- 19 10. Commissioning Team (CxT): The group of Parties involved in the commissioning process for any given
20 system. The Commissioning Team will include a core group involved with all systems. This core group
21 will typically include the CA, the Construction Manager's Commissioning Coordinator (CM-CxC), the
22 Owner's Commissioning Coordinator (O/O-CxC) and the General Contractor's Commissioning Coordinator
23 (GC-CxC). On any given system, the Commissioning Team will also include the Commissioning
24 Coordinator for the Contractor(s) responsible for the system or equipment.
- 25 11. Contractor: As used herein, 'Contractor' is a general reference to the installing Party and can therefore
26 refer to the General Contractor, subcontractors, or vendors as inferred by its usage. The contractor
27 generally refers to the person or entity who has agreed with the owner to perform work. Whereas the
28 subcontractor is any person other than the contractor who agrees to furnish or furnishes any supplies,
29 material, equipment, or services of any kind in connection with the work.
- 30 12. Construction Manager (CM): The Party retained by the Owner to represent the Owner and make
31 decisions on the Owner's behalf throughout the design and construction process.
- 32 13. Construction Phase: Phase of the project during which the facility is constructed and/or systems and
33 equipment are installed and started. Contractor and subcontractors complete the installation, complete
34 start-up documentation, submit operation and maintenance information, establish trends, and perform
35 any other applicable requirements to get systems started. Contractor and Vendors may also conduct
36 equipment specific training. The Construction Phase will generally end upon completed start-up and test,
37 adjust and balance of systems and equipment.
- 38 14. Deficiency: A condition in the installation or function of a component, piece of equipment or system that
39 is not in compliance with the Contract Documents (that is, does not perform properly or is not complying
40 with the design intent).
- 41 15. Engineer: Licensed Professional Engineer that designed and stamped the project reflecting his or her
42 specific area of certification and expertise.
- 43 16. Factory Authorized Representative: An individual fully trained on the equipment and certified by the
44 manufacturer to start-up equipment, perform the respective task, and make reports.
- 45 17. Factory Testing: Testing of equipment off-site at the manufacturer's facility. The testing may be
46 witnessed by the members of the project team.
- 47 18. Factory Start-Up: Start-up of equipment by a Factory Authorized Representative.
- 48 19. Functional Performance Testing (FPT): The detailed and thorough testing of building systems and their
49 interactions with building components and other building systems.
- 50 20. IAQ: Indoor Air Quality.
- 51 21. Installation, Operation and Maintenance (I,O&M) Documentation: This refers to Contractor-developed
52 documentation designed to address the needs of facilities personnel and customized for the context of
53 the specific facility and installation. The foundation of I,O&M Documentation is manufacturer's literature
54 (including 'installation and operational and maintenance manual', parts lists, troubleshooting guides, etc.)
55 as well as Contractor-developed instructions for start-up and shut-down, sequences, and other
56 installation-specific information. I,O&M Documentation content is a subset of the Facility Manual, so it is
57 common for only one or the other to be specified. All documentation shall be submitted to Owner in
58 electronic format. See Division 1, Section 01785 for additional information.

- 1 22. Measurement and Verification (M&V): Period after commissioning where systems are trended and
 2 analyzed for proper operations and for hitting energy savings requirements. This is a separate service
 3 apart from commissioning.
 4 23. Observation Log: This is a list that is maintained and updated by the commissioning provider that includes
 5 all Observation Items that relate to Commissioning activities and site observations requiring contractor
 6 action or response.
 7 24. OPR: Owner's Project Requirements. A document that details the functional requirements of a project
 8 and the expectations of how it will be used and operated. These include Project goals, measurable
 9 performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
 10 25. Opposite Season: The season opposite that when the majority of the testing occurs.
 11 26. Installation verification: Preliminary testing accomplished during a scheduled system outage to verify
 12 system functionality prior to placing the system/equipment into preliminary service.
 13 27. Start-Up: Refers to the quality control process whereby the Contractor verifies the proper installation of a
 14 device or piece of equipment, executes the manufacturer's starting procedures, completes the Start-Up
 15 Checklist, energizes the device, verifies that it is in proper working order and ready for dynamic testing,
 16 including Start-Up Tests.
 17 28. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately,
 18 they shall mean "as-built" systems, subsystems, equipment, and components.
 19 29. TAB: Can refer to the test, adjust, and balance process or the Testing, Adjusting, and Balancing
 20 Contractor.
 21 30. Transition Period: Time period after FPT completed to operate systems to purge the building and stabilize
 22 equipment operations. Time is also used by the CA to test system performance.
 23 31. Trending: Monitoring and recording a history of parameters typically using the BAS.
 24 32. Warranty Phase: Includes the early occupancy of the building and can continue through the Warranty
 25 Period and at least into the opposite season from when it was initially tested.
 26

27 1.05. COMMISSIONING TEAM

- 28 A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or
 29 she represents, explicitly organized to implement the commissioning process through coordinated action. The
 30 commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project
 31 superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CA.
 32 B. Members Appointed by Owner:
 33 1. CA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning
 34 team to implement the commissioning process. Owner will engage the CA under a separate contract.
 35 2. Representatives of the facility user and operation and maintenance personnel.
 36 3. Architect and engineering design professionals.
 37

38 1.06. OWNER RESPONSIBILITIES

- 39 A. Provide the OPR documentation to the CA and Contractor for information and use.
 40 B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
 41 C. Provide the BoD documentation, prepared by Architect and Engineer and approved by Owner, to the CA and
 42 Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance
 43 training plan.
 44

45 1.07. COORDINATION MANAGEMENT PROTOCOL

- 46 A. Coordination responsibilities and management protocols relative to Commissioning are initially defined below
 47 but will be refined and documented in the Commissioning Plan. Contractor shall have input in the protocols and
 48 all parties will commit to scheduled obligations. The CA will record and distribute.
 49 1. Submittals and Shop Drawings: CM shall distribute the submittal log to the CA. CA shall review the
 50 submittal log and communicate which submittals need to be forwarded.
 51 2. CA Review Comments for Shop Drawings: An email reply is sent directly to the CM, A/E, and Owner by
 52 the CA. The Owner and A/E will consider and incorporate at their discretion.
 53 3. Deficiencies Identified by the Commissioning Provider: When the CA identifies a deficiency the CA shall
 54 make a good faith assessment of responsible parties. Those parties, as well as the Owner and CM shall
 55 be notified of the perceived deficiency. This communication is FOR INFORMATION ONLY and is not a
 56 direction to resolve the deficiency or to take any action. Contractor may elect to accept responsibility
 57 and resolve the deficiency. If the contractor contests either the deficiency or responsibility for that
 58 deficiency, Contractor shall respond to that deficiency indicating disagreement. If responsibility is not

- 1 agreed to via the Commissioning dialogue, CM shall issue a work directive or RFI via the normal
 2 contractual channels to resolve the issue.
- 3 4. Requests for Meetings: In general request by the contractor for a meeting with the CA shall be routed
 4 through Owner and CM who will then determine the validity. Note that every attempt should be made
 5 to deal with Commissioning issues at regularly scheduled Commissioning Meetings.
- 6 5. Control Sequence Modifications: CA shall review the sequences during the design and submittal phases
 7 and address any known issues prior to the submittal approval. However, CA and the contractor may
 8 incorporate minor changes to the sequence during testing when it is apparent that it improves the
 9 control of the equipment but does not fundamentally change the sequence, subject to the approval of
 10 the Owner and Engineer. Any and all changes must be thoroughly documented in the record documents.
- 11 6. Notification of Completion Milestones: Contractor shall notify the CA, Owner and CM at least one week
 12 prior to any anticipated commissioning activity or commissioning milestone (such as FPT). The Owner or
 13 CM (as applicable) shall then coordinate the scheduling of the activity between all required parties.
 14 Notification shall be via email.
- 15 7. Observation Log: CA maintains a categorized Observation Log which tracks the Commissioning related
 16 action items. Any party that is copied on an email resulting from an Observation Item posting may
 17 respond to it and contribute to the dialogue. CA normally distributes a copy of the current open items on
 18 the action list with each site visit report.
- 19 8. Start-Up Checklist and Test Documents: Minimum start-up and documentation requirements are listed in
 20 the respective sections of the specifications for controls and mechanical commissioning. The Contractor
 21 then performs the reviewed and approved Start-Up procedures, completes the documentation and signs,
 22 and submits it. CA subsequently spot checks the procedures and documentation during the FPT. They
 23 are then included in the Commissioning Record.
- 24 9. Functional Performance Test Documents: FPTs are witnessed and documented by the CA but performed
 25 by the contractor. They are developed during the construction phase generally after completed
 26 submittals. CA drafts and forwards the FPT procedures to the CM to be subsequently distributed to the
 27 subcontractors for review by the CM. Contractors review and comment on the procedures. Throughout
 28 the Commissioning process, CA maintains a current record of the testing procedures and keeps the
 29 documentation up to date and accessible for all to access the current progress. Upon request, the CA will
 30 provide an electronic copy of completed functional test procedures at any significant stage of Cx.
- 31 B. Coordination Between Testing Parties
- 32 1. Factory Start-Ups: For many systems and equipment, Factory Start-Ups are specified. The Contractor is
 33 responsible for providing onsite support for the Factory representatives. These Factory Start-Ups will be
 34 reviewed and checked during FPT. All costs associated with the Factory Start-Ups are included with the
 35 bid unless otherwise noted. Contractor shall make notification of when Factory Start-Ups are occurring
 36 and coordinate these with witnessing Parties. The CA and CxT members may witness Factory Start-Ups at
 37 their discretion. Aspects of FPT accomplished during the Factory Start-Ups may be accomplished and
 38 approved by the CA if they meet the intent of the FPT. It is assumed that the Factory representatives
 39 budget the appropriate numbers of trips to support initial start-up, resolving equipment issues, TAB and
 40 training.
- 41 2. Independent Testing Agencies and Special Inspectors: For systems where contractor's independent
 42 testing agencies or special inspectors are specified, the cost of this testing is included with the bid unless
 43 otherwise noted. Much of the testing performed by these independent agencies or special inspectors
 44 will cover aspects required in the Start-Up Procedures and FPTs.
- 45 3. Contractor, testing agencies, and special inspectors shall coordinate with the CA so that the CA can
 46 support the testing (when necessary), witness the testing, and approve the applicable aspects of the
 47 FPTs. The Contractor should not start up equipment or systems without CA approval.
- 48 4. The CA may independently spot-check work of the testing agencies or special inspector if the tests were
 49 not witnessed. However, it is not the intent for the CA to re-accomplish testing by others that is specified
 50 in the construction specifications.
- 51 5. Contractor is responsible for coordinating the efforts of testing agency or special inspector with that of
 52 the Cx process. Documentation shall be contiguous and seamless and duplication will be avoided.
 53 Testing agencies or special inspectors shall complete the documentation of the Cx process as required.

54 1.08. CONTRACTOR RESPONSIBILITIES

- 55 A. Construction Phase: The following delineates the commissioning-related responsibilities of the Contractor (and
 56 their subcontractors) during the Construction Phase.
 57 1. Include Commissioning requirements in price and plan for work.
 58

- 1 2. Designate a CxC from each major subcontractor with activities related to commissioning. These CxCs are
- 2 to be the primary contacts for Commissioning activities.
- 3 3. Attend Construction Phase Commissioning Kick Off Meeting. The CxC and Project Manager from each
- 4 major subcontractor shall attend at a minimum.
- 5 4. The CxC shall attend all Commissioning progress meetings unless otherwise agreed to by the CA.
- 6 5. Remedy any deficiencies identified throughout construction.
- 7 6. Submit Start-Up Procedures along with the manufacturer's application, installation and start-up
- 8 information to the CA for review prior to implementation.
- 9 7. TAB shall submit Project specific TAB Plan and sample balancing forms for approval prior to starting work.
- 10 8. Contractor shall incorporate the Commissioning process into the construction schedule outlining generic
- 11 Commissioning tasks with precedents or prerequisites to each task. These tasks will apply to many
- 12 systems and the Contractor shall incorporate as such. Examples of enumerated tasks include:
- 13 a. Contractor preparation of the Training Plan.
- 14 b. Independent Testing Agency activities.
- 15 c. Contractor documentation of pipe pressure testing, flushing, and cleaning of applicable systems.
- 16 d. Documentation of the Start-Up Procedures for equipment and systems
- 17 e. TAB of applicable system
- 18 f. Training Events
- 19 g. Preparation of the O&M Manual content
- 20 h. FPT and Acceptance
- 21 i. Observation Period and System Optimization
- 22 j. Occupant or other Regulatory Agency testing or approval process
- 23 9. Coordinate the work of subcontractors, vendors, manufacturers, Testing Agencies and Special Inspectors
- 24 provided with the bid, and ensure that they are informed of and are adhering to the requirements of the
- 25 Commissioning process specified throughout the contract documents. Particular reference is made to
- 26 providing the required O&M Documentation; submittal of training materials and documentation of that
- 27 training; collaboration with the overall start-up and testing process; developing comprehensive
- 28 integrated procedures for scheduling and task notification and documenting them in a common format;
- 29 and electronic delivery requirements if applicable.
- 30 10. Provide assistance to the CA in preparation for the specific FPT procedures. Contractors, subcontractors
- 31 and vendors shall review the FPTs to ensure feasibility, safety and equipment protection and provide
- 32 necessary written alarm limits to be used during the tests. Damage caused to equipment performed in
- 33 accordance with the approved procedures that is the result of malfunctioning equipment or contract
- 34 deficiencies, shall be the responsibility of the Contractor.
- 35 11. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract
- 36 Documents, as required by reference or industry standards, and as specifically indicated elsewhere this
- 37 section. The Contractor (and subcontractors) shall record, in the form of photographs, compliance to
- 38 and/or deviation from IAQ standards.
- 39 12. Contractor shall notify the CA at least 7 days in advance of any tests, start-ups, or training. CA shall
- 40 witness selected tests and start-ups. Notification shall be accompanied by a schedule showing the
- 41 coordinated start date and task duration and all open prerequisites
- 42 13. Start-up, TAB of systems and equipment prior to verification and FPT by the CA. Start-up procedures shall
- 43 be in accordance with Contract Documents, reference or industry standards, and Commissioning specs.
- 44 Provide skilled technicians who are qualified to do the work required. Provide factory trained/authorized
- 45 technicians where required by the contract documents and stated in the applicable technical section.
- 46 Generally start-up and testing shall proceed from device checkout, to component checkout, to system
- 47 checkout, to inter-system checkout.
- 48 14. Record start-up and testing procedures on start-up forms or checklists and certify that the systems and
- 49 equipment have been started and/or tested in accordance with the requirements specified above. Each
- 50 task or item shall be indicated with the party actually performing the task or procedure.
- 51 15. Demonstrate the operation of all systems as specified.
- 52 16. Certify that systems have been installed and are operating per Contract Documents and OEM prior to FPT
- 53 and acceptance.
- 54 17. Support/Assist in the building flush-out per Construction Indoor Air Quality, Section 01561. If the flush-
- 55 out is not performed or is incomplete then the Contractor shall coordinate an air quality test from an
- 56 approved Industrial Hygienist after construction is complete to verify the chemical air contaminants are
- 57 below the specified limits.
- 58 18. Maintain an updated set of Record Documentation as required by the Contract Documents.

- 1 19. Conduct and document Equipment and Systems Training events as required by this Section and by
 2 applicable sections of the Specifications pertaining to each piece of equipment or system and general
 3 training requirements.
- 4 20. Operate systems under direction of the CA during FPT's and other acceptance testing.
- 5 B. Acceptance Phase: The following delineates the commissioning-related responsibilities of the Contractor (and
 6 their subcontractors) during the Acceptance Phase.
- 7 1. Will work in conjunction with CA in FPT and will generally include the following:
- 8 a. Operate and Manipulate systems and equipment to facilitate testing (as dictated in this section,
 9 relevant technical sections and the Commissioning Plan).
- 10 b. Operate and Manipulate BAS and other control systems to facilitate FPT (as dictated in this
 11 section, relevant technical sections and the Commissioning Plan).
- 12 c. Provide Point to Point and Devise Calibration reports prior to coordination to facilitate FPT.
- 13 2. Correct any work not in accordance with Contract Documents.
- 14 3. Maintain record documentation and update and resubmit it after Functional Completion.
- 15 4. Compensate the Owner for additional CA fees and expenses incurred to retest equipment and systems
 16 following testing failures.
- 17 5. Monitor systems, equipment and areas throughout the Acceptance Phase. Log and diagnose all alarms
 18 during this period. Maintain trends and logs of all parameters. Forward the logs and trends on a weekly
 19 basis throughout the Acceptance Phase.
- 20 C. Warranty Phase: The following delineates the commissioning-related responsibilities of the Contractor (and their
 21 subcontractors) during the Warranty Phase.
- 22 1. Provide warranty service.
- 23 2. Conduct BAS Sequence Training.
- 24 3. Respond to and document Warranty issues.
- 25 4. Participate as required in the opposite season testing.
- 26 5. Correct any deficiencies identified throughout the Warranty Phase.
- 27 6. Update record documentation to reflect any changes made throughout the Warranty Phase and resubmit
 28 final Record Drawings and data records at the close of the Warranty period.

30 1.09. DESIGN REVIEW

- 31 A. The A/E provides the CA a design development (DD) set for review; the drawing set should be near 100%
 32 complete. The CA reviews the design set for inconsistencies, misses, OPR & BOD compliance, and opportunities
 33 for improvement. The CA documents their comments and provides them to the A/E for incorporation into the
 34 design set.
- 35 B. The A/E provides a Construction Document (CD) set that is near 50% and/or 90% complete to the CA for review.
 36 The CA reviews the set to verify previous comments have been addressed and to identify any further misses or
 37 opportunities. The CA documents their comments and provides them to the A/E for incorporation into the
 38 construction set.

40 1.10. COMMISSIONING PLAN

- 41 A. The CA will develop the Commissioning Plan and its elements shall be included in the project schedule when
 42 approved by the owner or construction manager. The following provides an overview of the Commissioning
 43 tasks discussed in the Commissioning Plan.
- 44 1. Commissioning program overview - Goals & Objectives, general project information, system to be
 45 commissioned
- 46 2. Commissioning team - Team members, roles & responsibilities, communications & protocols, meetings
 47 and management
- 48 3. Commissioning process activities - Document owner's project requirements, review the basis of designs,
 49 review submittals, development of system functional performance testing, verify system performance,
 50 report deficiencies & the resolution process, accepting the building system and training
- 51 4. Commissioning schedule - A commissioning schedule will typically include start and end dates for the
 52 following.
- 53 a. Design set review
- 54 b. CD set review
- 55 c. Bid packages released
- 56 d. Distributed power available
- 57 e. Distributed water available
- 58 f. Start-up tests

- 1 g. Point to Point
- 2 h. TAB
- 3 i. Functional performance testing
- 4 j. Training
- 5

1.11. OBSERVATION LOG

- 7 A. CA shall maintain an Observation Log (required information, identified deficiencies, work required, etc.) that
- 8 relates to Commissioning. Each item shall be tracked with the initiator, the parties responsible, due date, the
- 9 date of closure, and a description of the resolution. Each item shall be categorized for sorting and tracking and
- 10 for documentation on applicable forms.
- 11 B. CA will disseminate this list as appropriate to keep all parties informed.
- 12 C. All parties indicated as responsible for an action item shall respond. The preferred response method is via e-
- 13 mail. Response with a plan of action (either repair or plan to resolve) is expected within 48 hours.
- 14

1.12. SUBMITTAL

- 16 A. The CA will provide appropriate contractors with a specific request for the type of submittal documentation the
- 17 CA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal
- 18 process and protocol of the construction team. At minimum, the request will include the manufacturer and
- 19 model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of
- 20 operation, O&M data, performance data, any performance test procedures, control drawings and details of
- 21 owner contracted tests. In addition, the installation and checkout materials that are actually shipped inside the
- 22 equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be
- 23 submitted to the Commissioning Provider. All documentation requested by the CA will be included by the Subs
- 24 in their O&M manual contributions.
- 25 B. The Commissioning Provider will review and provide comment on submittals related to the commissioned
- 26 equipment for conformance to the Contract Documents as it relates to the commissioning process, to the
- 27 functional performance of the equipment and adequacy for developing test procedures. This review is intended
- 28 primarily to aid in the development of functional testing procedures and only secondarily to verify compliance
- 29 with equipment specifications. The Commissioning Provider will notify the CM, Owner Representative, or A/E as
- 30 requested, of items missing or areas that are not in conformance with Contract Documents and which require
- 31 resubmission.
- 32 C. The CA may request additional design narrative from the A/E and Controls Contractor, depending on the
- 33 completeness of the design intent documentation and sequences provided with the Specifications.
- 34 D. These submittals to the CA do not constitute compliance for O&M manual documentation. The O&M manuals
- 35 are the responsibility of the Contractor, though the CA will review and approve them.
- 36 E. Contractor's responsibility for deviations in submittals from requirements of the Contract Documents is not
- 37 relieved by the Commissioning Provider's review.
- 38

PART 2 - PRODUCTS**2.01. INSTRUMENTATION**

- 42 A. All test instruments described in this section shall be acceptable for any portion of the commissioning process
- 43 herein described. All instruments shall conform to the standards specified in the most recent edition of "NEBB
- 44 Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" in regard to accuracy and
- 45 calibration status. Current calibration certificates must be available to the CA as requested.
- 46 B. Test instrument accuracy and resolution must match or exceed that of the system component being verified or
- 47 calibrated.
- 48 C. Test instruments must be used within guidelines as recommended by instrument manufacturer. All measuring
- 49 methods must be appropriate to the instrument application and measurements must be repeatable under
- 50 equivalent conditions.
- 51 D. Standard Testing Instrumentation: Standard instrumentation normally used for performance assessment and
- 52 diagnosis will be provided by Contractor. These include:
 - 53 1. Electronic Manometer (for Air and Flow Hood)
 - 54 2. Electronic Manometer (for Water)
 - 55 3. Temperature Instruments
 - 56 4. Humidity Instruments
 - 57 5. CO2 Instrument
 - 58 6. Sound Meter

- 1 7. Electronic Multimeter
- 2 8. Tachometer
- 3 9. Ultrasonic Flow Meter
- 4 10. Thermal Infrared Camera
- 5 11. Others as required
- 6

7 **PART 3 - EXECUTION**

8

9 **3.01. INSTALLATION VERIFICATION**

- 10 A. All equipment, components, and devices applicable to installation verification must be installed, and the
11 installation verification must be documented and approved. This includes installation, identification labeling,
12 insulation, and all other requirements for placing systems into dynamic operation.
- 13 B. Required submittal documentation shall be present and located convenient to testing area. Validate that all
14 required documentation has been submitted and is per the contract requirements.
- 15 C. Contractor shall provide the completed installation verification procedures at the time of testing. CA shall review
16 the installation verification procedure documentation and spot-check at the beginning of Start-Up.
- 17 D. Contractor shall demonstrate that access is sufficient to perform required maintenance.
- 18 E. System and equipment configurations shall be compared against the contract documents.
- 19

20 **3.02. START-UP CHECKS**

- 21 A. All equipment, components, and devices applicable to the FPT must be started, and the Start-Up must be
22 documented and approved. This includes completion of Start-Up Procedures, pressure testing (of equipment,
23 duct and piping), flushing/cleaning, identification labeling, insulation, and all other requirements for placing
24 systems into dynamic operation.
- 25 B. Unless specifically agreed to by the Owner and CA, all support systems shall be complete prior to FPT. For
26 instance, an air handler will require that:
 - 27 1. The electrical system serving it is completed and tested.
 - 28 2. The hydronic systems serving it have been pressure tested, flushed, and functional performance tested.
 - 29 3. Balancing has been completed.
 - 30 4. The control systems have been started and calibrated.
 - 31 5. The CA shall determine the optimal sequence of testing.
- 32 C. Required submittal documentation shall be present and located convenient to testing area. Validate that all
33 required documentation has been submitted and is per the contract requirements.
- 34 D. Contractor shall provide the completed Start-Up Procedures at the time of testing. CA shall review the Start-Up
35 Procedure documentation and spot-check at the beginning of FPT.
- 36 E. Contractor shall demonstrate that access is sufficient to perform required maintenance.
- 37 F. BAS trends shall have been established as required in the documents. These shall generally be reviewed prior to
38 or during FPT.
- 39 G. Capacities and adjusted/balanced conditions as applicable shall be subject to review.
- 40 H. Sequencing Verification: For applicable systems and equipment, all modes of operation shall be verified for
41 proper sequencing.
- 42 I. System and equipment configurations shall be compared against the contract documents.
- 43 J. Verify Modes (such as heating and cooling) are coordinated and do not overlap or 'fight'.
- 44 K. All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as
45 applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation.
- 46 L. BAS or Local Panel Dynamic Graphics: The graphic displays for all components, systems, and areas required to be
47 represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when setpoints or other
48 parameters are required to be adjustable, CA shall verify that they can be adjusted directly from the graphic
49 screen.
- 50

51 **3.03. START-UP PROCEDURE**

- 52 A. Purpose: The Commissioning process requires that the normal quality control processes involved with preparing
53 systems and equipment for operation are performed to a high standard of care and are thoroughly documented.
54 The required commissioning-related Start-Up Procedures involve nothing additional over that which would be
55 done for a proper installation. These procedures shall be performed on all installed systems and equipment and
56 no sampling strategy is used for the start-up process. The Commissioning process requires all Parties to
57 collaborate to establish the optimal standard of care for starting systems and equipment. After the procedures

- 1 are established, the Contractor performs them and documents them with the Start-up Procedures that are
 2 developed by the Contractor.
- 3 B. Start-Up Procedures: The content of these Start-Up Procedures shall provide the minimally acceptable content in
 4 accordance with the OEM field quality control requirements. These procedures and protocols will normally be
 5 common across different manufacturers.
- 6 C. Content of Start-Up Procedures: Start-Up Procedures shall generally include the following for each item of
 7 equipment or system (as applicable):
- 8 1. Project-specific designation, location and service.
 - 9 2. Indication of the Party performing and documenting the Start-Up Procedure.
 - 10 3. Clear explanation of the inspection, test, measurement, and outcome with a Pass/Fail indication and a
 11 record of measure parameters.
 - 12 4. A Start-up Checklist item indicating that proper maintenance clearances have been maintained.
- 13 D. Recording and Documentation of Factory Start-Up: Manufacturer's start-up protocols shall be executed and
 14 forms shall be completed by a qualified/authorized technician.
- 15 E. Recording and Documentation of non-Factory Start-Up: The start-up tests and checklists shall be completed by a
 16 qualified technician.
- 17 F. Commissioning Provider Review: CA will review and spot-check procedures during FPT.
- 18 G. Documentation Completion: The individual executing the start-up must complete the start-up and pre-functional
 19 documentation for any given equipment and acknowledge acceptability with the indication of who did the
 20 associated task.
- 21 H. Sampling and Final Submission: All (100% of) systems are started and documented per the approved procedures
 22 and NO sampling strategy is used. Completed Start-up and pre-functional checklists for all pieces of equipment
 23 associated with independent systems shall be submitted to CA prior to any associated FPT. Any outstanding item
 24 shall be clearly indicated and an associated Action Item must be entered to track resolution.
- 25 I. Owner Access: Contractor shall allow access by Owner representatives to inspect the equipment and ensure its
 26 proper operation.

27 28 3.04 POINT TO POINT VERIFICATION

- 29 A. A documented, comprehensive point to point and basic function testing in the field is required on all
 30 installations. Factory calibration and bench tests are not acceptable alternates to onsite field-testing.
- 31 B. Point-to-point (or calibration verification) scope of work consists of testing from all end field devices (any device
 32 that provides an input signal to, or receives an output signal from the control hardware) through proper
 33 input/output to the graphic and operator interface. Testing must be complete, detailed and documented on
 34 approved point to point verification forms. Point-to-point should be performed with a separate device from the
 35 installation sensor - "ringing out a sensor" alone is not an acceptable level point-to-point testing. Point-to-point
 36 testing forms will include all point database requirements (i.e. alarm priority, paging, email, device range, etc.).
- 37 C. Submittal of the control provider's forms for approval must take place 3 weeks prior to commencement of field
 38 testing. The point-to-point report summary documentation must include the signature of the test technicians
 39 and date completed. The technician's signature certifies that the system has been tested and is fully ready for
 40 the commissioning lead's performance verification testing.
- 41 D. The CA will select up to 10% of the readings from the BAS Reports and spot check them, as part of the time
 42 allocations for the various systems. If subsequent failures are found, the Controls contractor will be required to
 43 justify noted failures or re-verify and re-document the system.
- 44 E. The maximum failure rate for this sample is 10%. The readings selected by the CA may include air temperature,
 45 fluid temperature, air flow rate, liquid flow rate, differential pressure, gage pressure, relative humidity, CO
 46 concentration, CO2 concentration, and refrigerant monitoring.
- 47 F. For all readings a deviation of more than the below between the verification reading and reported data shall be
 48 considered as failing the FPT

Sensor Application

Accepted BAS Tolerance

Airflow (Pressurized Spaces)	± 3 %
Airflow (Measuring Stations)	± 5 %
Airflow (Terminal)	± 10 %
Air Pressure Differential (Space)	± .001 in wg
Air Pressure (Ducts)	± .01 in wg

Air Relative Humidity	± 2 % RH
Air Temperature (Ducted)	± 1 deg F
Air Temperature (Room, AC unit, TU, etc.)	± 1 deg F
Air Temperature (Outside)	± 2 deg F
Air Wet Bulb Temperature Outdoor (Dew point)	± 2 deg F
Air Wet Bulb Temperature Indoor (Dew point)	± 1 deg F
Air Temperature Differential	± .25 deg F
Carbon Dioxide Monitor	± 50 PPM (of mid-range)
Carbon Monoxide Monitor	± 5 % (of mid-range)
Oxygen Monitor	± 5 %
Refrigerant Monitor	± 5 % (at 50 PPM)
Fluid Flow	± 5 %
Fluid Pressure	± 2 % (of full-scale)
Fluid Temperature	± 1 deg F
Electrical	± 5 %
Thermal Energy	± 5 %
Steam Flow	± 5 %
Steam Temperature	± 2 deg F
Vibration	± 5 %

1 ■Notes:

2 *Accepted calibration tolerances will vary according to measured medium and application of sensors. The tolerances*

3 *listed are standard accepted criteria.*

4 *Not all sensors listed above may be in the project.*

5

6 **3.05 TEST, ADJUST, AND BALANCE**

- 7 A. CA shall review TAB Plan, Draft / Final TAB reports.
- 8 B. The CA will select up to 10% of the readings from the Balancing Reports and spot check them, as part of the time
- 9 allocations for the various systems. If subsequent failures are found, the TAB contractor will be required to
- 10 justify noted failures or rebalance and re-document the system.
- 11 C. The maximum failure rate for this sample is 10%. The readings selected by the CA may include supply air diffuser
- 12 readings (both minimum and maximum readings for variable air volume boxes), main and branch supply duct
- 13 traverse readings, outside/return air flow readings, exhaust air flow readings, water flow readings, amp readings,
- 14 and water pressure drop readings through coils, heat exchangers, and other hydronic elements.
- 15 D. For all readings a deviation of more than 10% between the verification reading and reported data shall be
- 16 considered as failing the FPT.

17

18 **3.06 FUNCTIONAL PERFORMANCE TESTING**

- 19 A. Objectives and Scope:
- 20 1. The objective of FPT is to demonstrate that each system is operating according to the documented design
- 21 intent and Contract Documents. Functional testing facilitates bringing the systems from a state of
- 22 substantial completion to full dynamic operation. Additionally, during the testing process, areas of
- 23 deficient performance are identified and corrected, thus improving the function and operation of the
- 24 systems.
- 25 2. Each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, warm-
- 26 up, cool-down, normal [and emergency power], fire alarm, part- and full-load) where there is a specified
- 27 system response. Verifying each sequence in the sequences of operation is required. Proper responses
- 28 to such modes and conditions as power failure, freeze condition, no flow, equipment failure, etc. shall
- 29 also be tested.
- 30 B. Development of Test Procedures:
- 31 1. CA shall develop specific test procedures and forms to verify and document proper operation of each
- 32 piece of equipment and system. Prior to execution, the CA shall provide a copy of the test procedures to

- 1 the Contractor who shall review the tests for feasibility, safety, equipment and warranty protection, and
2 scope. The CA will also submit the tests to Owner for Review.
- 3 2. Contractor shall review the FPTs in detail and submit edits and comments to the CA for possible
4 incorporation.
- 5 3. The purpose of any given specific FPT is to verify and document compliance with the stated criteria of
6 acceptance, modes of operation and performance.
- 7 C. Scheduling: After Contractors' notification that systems are ready for testing and submittal and review of all the
8 required submittals has occurred, CM shall schedule the testing. To the extent practical, tests shall be scheduled
9 to allow efficient and contiguous testing of inter-related systems and equipment.
- 10 D. Phasing: Non-interdependent segments of the project testing can be phased. Phasing of this project will be
11 determined as the project progresses.
- 12 E. Participation: CA will direct, witness and document FPTs performed by the contractor after Start-Up Procedure
13 documentation of systems and equipment has been reviewed and accepted. CA will orchestrate the execution
14 of the FPTs unless otherwise specified. Contractor shall perform the FPTs as described in section 3.6 with
15 manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders,
16 specialty test equipment, safety equipment), and on-the-spot remediation of minor identified deficiencies
17 whenever possible.
- 18 1. Required participating Parties shall be indicated in the individual FPT. Typically, multiple Parties are
19 required for any given test, yet participation for any given Party is only required for the respective
20 portion of the test for which the Party is responsible.
- 21 2. Frequently, on multiple samples where a given party does not directly perform the test, the participation
22 of that party will only be required for an initial quantity of systems/equipment. Whenever practical and
23 at the discretion of the CA with the contractor's full approval, the CA will continue with the remaining
24 portion of the sample without assistance from the Contractor(s) not directly performing the test.
25 However, the Contractor is allowed to be present for any or all FPTs conducted.
- 26 3. The required parties shall be available on-site throughout the testing of any given system for which they
27 are required participants. Therefore, time for which they are not directly involved can be spent
28 performing other work (typically addressing identified punch list items or failed tests).
- 29 4. No party involved with the project is prohibited from participation in or witnessing of any tests. Any
30 Contractor may elect to witness all tests on their systems even if their involvement is not directly
31 required (for instance, BAS Vendor involvement is sometimes required on the first few of a sample and
32 not on the entire sample).
- 33 5. CA will endeavor to coordinate effectively with the individual Contractors throughout FPT and minimize
34 their required involvement.
- 35 F. Completeness: All systems must be completed and ready for FPT. All start up, factory authorized field testing,
36 independent testing agency tests, and TAB procedures must be complete and the control systems must be
37 tested and started for the respective system or component.
- 38 G. Test Documentation: CA will witness and document the tests. CA will record all test results on the forms
39 developed for the testing. CA will 'Pass' or 'Fail' the testing and record the date and time of the test.
40 Deficiencies shall clearly be indicated when the test is failed. When all related testing is completed successfully,
41 CA shall recommend acceptance of the system or component. In the case of specialized testing, witness (at CA's
42 discretion) and review the testing reports prepared by the Contractor.
- 43 H. After functional testing is completed all settings adjusted to test the equipment/system will be returned to
44 normal.
- 45 I. FPT Acceptance:
- 46 1. The Acceptance Criteria shall be as follows unless specifically indicated within applicable individual
47 specification sections or test procedures. CA may exercise professional judgment to relax requirements
48 and pass tests and recommend approval by the Owner and Engineer when appropriate.
- 49 2. Accuracy/repeatability on sensing devices will be as specified for the device. CA and TAB will use
50 calibrated gages for independent validation and use judgment in passing or failing the devices. In many
51 cases, the coordination of multiple related sensors is more important than absolute accuracy.
- 52 3. HVAC sequence-related criteria will be as explicitly specified in the documents and as interpreted by the
53 CA.
- 54 4. Testing may be deferred due to seasonal or operational constraints. In either situation the testing will be
55 coordinated and be governed by the specifications for the project.
- 56 J. FPT Deficiencies:
- 57 1. Non-Conformance: Non-conformance deficiencies identified during FPT shall be resolved as follows:

- 1 a. The CA will record the results of the functional test. All deficiencies or non-conformance issues
 2 shall be noted as Observation Log Items and reported to the Owner and CM.
 3 b. Corrections of identified minor deficiencies may be made during the tests at the discretion of the
 4 CA. In such cases the deficiency will be noted on the FPT documents.
 5 c. Every effort will be made by the CA to expedite the testing process and minimize unnecessary
 6 delays, while not compromising the integrity of the procedures.
 7 d. As tests progress and deficiencies are identified, the CA will discuss the issue with the executing
 8 Contractor.
 9 e. When there is no dispute on the deficiency and the Contractor accepts responsibility to correct it:
 10 i. The CA shall document the deficiency along with the Contractor's response and intentions,
 11 and they go on to another test or sequence. A copy/email of the deficiency shall be
 12 generated and provided to the Contractor and CA. The Contractor corrects the deficiency,
 13 completes the Action Item response certifying that the issue is resolved and/or the
 14 equipment is ready to be retested, and sends it back to the CA.
 15 ii. The CA reschedules the test and the test is repeated.
 16 f. If there is a dispute about a deficiency, regarding whether it is a deficiency and/or who is
 17 responsible:
 18 i. The deficiency shall be documented as an Observation Log Item with the Contractor's
 19 response and the Owner and CM will be notified. The CM will track this issue under the
 20 construction contract dispute resolution provisions.
 21 ii. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner
 22 and CM.
 23 iii. The CA documents the resolution to the Observation Log Item.
 24 iv. Once the interpretation and resolution have been decided, the appropriate party corrects
 25 the deficiency, and responds to the Action Item indicating completion. The CA reschedules
 26 the test and the test is repeated until satisfactory performance is achieved. CA then closes
 27 the Action Item.
- 28 K. Max Failure Limit and Sample Percentages: A Maximum Failure Limit is indicated along with the Sampling
 29 Percentages. The Max Failure Limit indicates the maximum percentage of the tested devices that may have any
 30 test that fails before an entirely new sample must be tested. This is based on the concept that if many failures
 31 occur, it is a result of inadequate start-up by the Contractor. When the maximum number of failures is reached,
 32 testing on that sample will be terminated and re-testing will be scheduled.
 33 1. If no Max Failure Limit is indicated, all tested samples must pass (Max Failure Limit 0%).
 34 2. Where sample tests involve multiple systems (i.e., checking strainers on different hydronic systems) the
 35 Maximum Failure Limit will apply per system.
 36 3. The responsible Contractors shall reimburse the Owner for the CA's cost of that sample test, and redo the
 37 start-up and TAB for the applicable devices/systems.
 38 4. All work necessitated by sample failures shall be at no cost to the Owner.
- 39 L. Failure Due to Manufacturer's Defects: If 10% of identical pieces of equipment fail to perform to the Contract
 40 Documents (mechanically or substantively) due to manufacturing defect, all identical units may be considered
 41 unacceptable by the CM. (For the purposes of defining 'identical equipment' for this Section, size or capacity
 42 alone does not constitute a difference.) In case of failure due to manufacturer's defects, the Contractor shall
 43 provide the Owner with the following:
 44 1. Manufacturer's response in writing as to the cause of the failure and proposed resolution.
 45 2. Manufacturer shall implement their proposed resolution on a representative sample of the product.
 46 3. The CM will determine whether a replacement of all identical units or a repair is acceptable.
 47 4. Upon acceptance, the manufacturer shall replace or repair all identical items at their expense and shall
 48 extend the warranty accordingly (if the original equipment warranty had begun).
 49 5. Manufacturer shall pay the costs of all retesting necessitated by the failure.

51 3.07 ACCEPTANCE

- 52 A. The CA notes each satisfactorily demonstrated function on the test form. Formal approval of the functional test
 53 is made later after review by the CA and by the CM, if necessary. The CA recommends acceptance of each test to
 54 the CM using a standard form. The CM gives final approval on each test using the same form, providing a signed
 55 copy to the CA and the Contractor.

57 3.08 CLOSEOUT

- 58 A. Commissioning Report:

- 1 1. A final summary report (about four to six pages, not including backup documentation) by the CA will be
- 2 provided to the CM, focusing on evaluating commissioning process issues and identifying areas where the
- 3 process could be improved.
- 4 2. All acquired documentation, logs, minutes, reports, deficiency lists, communications, findings, unresolved
- 5 issues, etc., will be compiled in appendices and provided with the summary report.
- 6 3. Installation verification, Start Up checklists, TAB, functional tests and monitoring reports will not be part
- 7 of the final report, but will be stored in the Commissioning Record in the I,O&M manuals.
- 8 4. Off season testing and additional factory start-ups shall clearly be identified and the designated test
- 9 period noted for contractor and owner coordination. See Warranty Period.
- 10 B. Code Required Reports:
- 11 1. Provide Contractor with all commissioning reports required by state and local authorities for compliance
- 12 with governing energy code and mechanical code.
- 13

14 3.09 TRAINING

- 15 A. The CM shall be responsible for training coordination and scheduling and ultimately for ensuring that training is
- 16 completed.
- 17 1. A training plan shall be generated and include the following elements:
- 18 a. Equipment
- 19 b. Intended audience
- 20 c. Location of training
- 21 d. Objectives
- 22 e. Subject covered (description, duration of discussion and special methods)
- 23 f. Instructor for each subject
- 24 g. Method of instruction (classroom lecture, manufacturer video, site walk through, actual
- 25 operational demonstration, written handouts)
- 26 2. The controls contractor shall attend any training in which their system interfaces (minimally mechanical)
- 27 3. Recommended training
- 28 a. Use printed installed ad O&M manuals
- 29 b. Review of O&M - include start-up, all modes of operation, shutdown, seasonal changes, and
- 30 emergency operations (emphasis should be given on safety and proper operations).
- 31 c. Health and safety issues
- 32 d. Warranties and guarantees
- 33 e. Common troubleshooting
- 34 f. Peculiarities
- 35 g. Overrides
- 36 B. The CA shall be responsible for overseeing and approving the content and adequacy of the training of Owner
- 37 personnel for commissioned equipment.
- 38

39 3.10 INSTALLATION, OPERATION AND MAINTENANCE

- 40 A. Prior to substantial completion, the CA shall review the I,O&M manuals, documentation and redline as-builds for
- 41 systems that were commissioned to verify compliance with the Specifications. The CA will communicate
- 42 deficiencies in the manuals to the CM or A/E, as requested.
- 43 B. Upon a successful review of the corrections, the CA recommends approval and acceptance of these sections of
- 44 the O&M manuals to the CM or A/E.
- 45 C. The CA also reviews each equipment warranty and verifies that all requirements to keep the warranty valid are
- 46 clearly stated. This work does not supersede the A/E's review of the I,O&M manuals according to the A/E's
- 47 contract.
- 48

49 3.11 WARRANTY REVIEW

- 50 A. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's
- 51 design) shall be completed as part of this contract. The CA shall coordinate this activity. Tests will be executed,
- 52 documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CA witnessing. Any
- 53 final adjustments to the I,O&M manuals and as-builds due to the testing will be made.
- 54

55 END OF SECTION

**SECTION 01 95 00
MEASUREMENT AND VERIFICATION**

PART 1 GENERAL

1.01 OVERVIEW

- A. This Measurement and Verification (M&V) plan is based on Option D: Calibrated Simulation of the *International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003*. The plan is intended to verify the cost savings associated with energy efficiency measures incorporated into the design, and to provide a recalibrated energy model that will serve as a tool for building operators in identifying and remedying causes of underperformance.

1.02 SCOPE OF WORK

- A. McKinstry is primarily responsible for the M&V Plan’s development, coordination and implementation. The project owner and building operations staff will support implementation of the plan
- B. A comprehensive measurement and verification plan will be developed which will detail the project milestones listed below:

Baseline energy model
Recalibrate baseline energy model to reflect as-built and post-occupancy conditions
Identification of ECMs for inclusion in the M&V plan
Development of M&V plan
Compilation of all occupancy, controls, BAS data, and scheduling information during the M&V period
Spot metering during M&V period
Specification of required sub-metering equipment
M&V Report
Corrective Action Plan (if necessary)

1.03 MEASUREMENT & VERIFICATION TEAM

- A. The measurement & verification team as referred to in all sections will consist of the job-specific group responsible for performing M&V duties throughout the project lifecycle. The primary point of contract is the project’s performance assurance specialist at McKinstry.
- B. Additional parties crucial to the process but not directly responsible for Measurement & Verification in the capacity of those listed above are:
 1. Mechanical Contractor Project Manager
 2. Mechanical Field Foremen
 3. Mechanical Design Engineer
 4. Control Contractor Representative
 5. General Contractor Representative
 6. Electrical Contractor Representative
- C. The nature of the process requires a significant amount of communication between and participation of all members listed above.

1.04 MEASUREMENT & VERIFICATION PLAN

- A. Prior to project commencement the McKinstry team shall develop a comprehensive measurement & verification plan which will address the following:

1.05 INSTRUMENTATION

- A. All test instruments described in this section shall be acceptable for any portion of the measurement & verification process herein described. All instruments shall conform to the standards specified in the most recent edition of “International Performance Measurement and Verification Protocol (IPMVP)” regarding accuracy and calibration status. Current calibration certificates must be available.
- B. Test instrument accuracy and resolution must match or exceed that of the system component being verified or calibrated.

- C. Test instruments must be used within guidelines as recommended by instrument manufacturer. All measuring methods must be appropriate to the instrument application and measurements must be repeatable under equivalent conditions.
- D. The M&V team shall assume full responsibility for safekeeping of all instrumentation during the course of work.

PART 2 EXECUTION

2.01 PRE-CONSTRUCTION

- A. During the pre-construction phase, the measurement & verification team shall be available to all concerned parties in a consulting capacity. The role of the team in the construction phase affords them with practical knowledge that can be applied during the design and construction scheduling processes. Pre-construction input is intended to reduce or eliminate issues that have historically hindered timely project completion or have caused unanticipated project cost impact. Examples include:
 - 1. Engineering design issues.
 - 2. Manufacturer-specific equipment performance.
 - 3. System control strategies and metering selection
 - 4. Subcontractor performance.
 - 5. Project scheduling conflicts.
 - 6. Owner / contractor expectations.

2.02 POST-INSTALLATION EQUIPMENT MONITORING

- A. Following installation and before occupancy, commissioning activities were used to verify the proper fundamental operations of the building systems. Should a component of an ECM fail to work in the designed manner, maintenance will be performed to restore the equipment to its designed operation. Permanent and spot metering will be used to measure electrical consumption. Operation staff will use metered trend data and spot checks to identify underperforming systems so that corrective action can be taken.
- B. The method of metering will be through sealed electronic sub meters, these meters will record the electrical loads indicated within this plan. This project will require both electric submeters by building on campus as well as heating and cooling system monitoring (temperature delta and flow metering) These meters are intended to validate the anticipated energy savings previously indicated in LEED EAc1 and as indicated below. Recalibration of the meters can be done by sending these meters back to the factory, contacts with these vendors have indicated that this is typically done every five years.

2.03 M&V PERIOD VERIFICATION ACTIVITIES

- A. On a monthly basis, operations staff shall record the energy consumption of loads associated with ECMs. Also record any significant O&M activities performed on the systems during that time period, including any associated costs. At the end of the one-year M&V period, summarize the electrical consumption data for comparison with the recalibrated baseline and expected consumption. The metered equipment shall be inspected at the conclusion of the M&V period and as needed to verify proper operation. All collected information and comparison results will be included in the M&V report.
- B. All efforts will be made to prevent the omission or loss of metered data. In the event that data is missing or lost, existing data from before and after the missing portion will be used to extrapolate if appropriate. Extension of the M&V period is also an option for mitigating the effect of lost data.

2.04 BUILDING AUTOMATION SYSTEM LOGGING/TRENDING

- A. The schedule of point trends will be developed by McKinstry and shared with the project team upon project execution and DDC system selection.
- B. The BAS includes data logging functions that will also be used to provide ongoing measurement and verification data pertaining to certain mechanical systems. BAS data will be used in conjunction with metered electricity to track equipment performance, identify underperforming systems. This data will also be used to assist the baseline energy model recalibration. The table below shows the metering strategy that will be used to monitor mechanical systems that use electricity.

END OF SECTION

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL – THIS SECTION NOT USED

PART 2 PRODUCTS – THIS SECTION NOT USED

PART 3 EXECUTION

3.1 SCOPE

- A. Remove code level electrical, lighting, HVAC, and fire suppression system within new construction area and relocate according to new construction scope of work. Coordinate with overall building construction and project schedule to maintain operation as required for construction and code.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 3. Do not close or obstruct roadways or sidewalks without permit.
 - 4. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- B. Do not begin removal until receipt of notification to proceed from City of Madison.

3.3 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to City of Madison.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to City of Madison.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment and reconnect according to new construction scope of work.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- B. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.5 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 74 19 – Construction Waste Management and Disposal.

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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sheathing.
- B. Preservative treated wood materials.
- C. Fire retardant treated wood materials.
- D. Concealed wood blocking, nailers, and supports.
- E. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- C. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
- D. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
- G. PS 20 - American Softwood Lumber Standard; 2015.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.3 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

- 1 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
2

3 **2.4 FACTORY WOOD TREATMENT**

- 4 A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments
5 determined by use categories, expected service conditions, and specific applications.
6 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified
7 requirements.
8 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency,
9 certifying level and type of treatment in accordance with AWPA standards.
10 B. Fire Retardant Treatment:
11 1. Manufacturers:
12 a. Arch Wood Protection, Inc; www.wolmanizedwood.com.
13 b. Hoover Treated Wood Products, Inc; www.frtw.com.
14 c. Koppers, Inc; www.koppers.com.
15 2. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated;
16 capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no
17 evidence of significant combustion when test is extended for an additional 20 minutes both before and after
18 accelerated weathering test performed in accordance with ASTM D2898.
19 a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for
20 plywood.
21 b. Treat all exterior rough carpentry items.
22 c. Do not use treated wood in direct contact with the ground.
23 C. Preservative Treatment:
24 1. Manufacturers:
25 a. Lonza Group: www.wolmanizedwood.com
26 b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com
27 c. Viance, LLC; Preserve ACQ: www.treatedwood.com/#sle
28 d. Substitutions: See Section 01 6000 – Product Requirements.
29 2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification
30 A using waterborne preservative.
31 a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
32 b. Treat lumber exposed to weather.
33 c. Treat lumber in contact with masonry or concrete.
34 d. Treat lumber in other locations as indicated.
35 e. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment
36 chemicals for brush-application in the field.
37

38 **PART 3 EXECUTION**

39
40 **3.1 PREPARATION**

- 41 A. Coordinate installation of rough carpentry members specified in other sections.
42

43 **3.2 INSTALLATION - GENERAL**

- 44 A. Select material sizes to minimize waste.
45 B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including:
46 shims, bracing, and blocking.
47 C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient
48 to remove indoor air contaminants.
49

50 **3.3 BLOCKING, NAILERS, AND SUPPORTS**

- 51 A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
52 B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to
53 close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to
54 code authorities may be used in lieu of solid wood blocking.
55 C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely
56 attached to stud framing.

- 1 D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely
- 2 fastened to two or more studs or other method of support is explicitly indicated.
- 3 E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of
- 4 support is explicitly indicated.
- 5 F. Provide the following specific non-structural framing and blocking:
- 6 1. Cabinets and shelf supports.
- 7 2. Wall brackets.
- 8 3. Handrails.
- 9 4. Grab bars.
- 10 5. Towel and bath accessories.
- 11 6. Wall-mounted door stops.
- 12 7. Chalkboards and marker boards.
- 13 8. Wall paneling and trim.
- 14 9. Joints of rigid wall coverings that occur between studs.
- 15

16 **3.4 INSTALLATION OF CONSTRUCTION PANELS**

- 17 A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using
- 18 nails, screws, or staples.
- 19

20 **3.5 TOLERANCES**

- 21 A. Framing Members: 1/4 inch from true position, maximum.
- 22 B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.
- 23

24 **3.6 CLEANING**

- 25 A. Waste Disposal: Comply with the requirements of Section 01 74 19 - Construction Waste Management and Disposal.
- 26 1. Comply with applicable regulations.
- 27 2. Do not burn scrap on project site.
- 28 3. Do not burn scraps that have been pressure treated.
- 29 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy"
- 30 facilities.
- 31 B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- 32 C. Prevent sawdust and wood shavings from entering the storm drainage system.
- 33
- 34
- 35
- 36

END OF SECTION

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SECTION 06 15 00
WOOD DECK TILES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wood Deck Boards.
- B. Wood Deck Tiles.
- C. Pedestal supports for Deck Tiles.

1.2 RELATED REQUIREMENTS

- A. Section 01 81 13 - Sustainable Design Requirements – LEEDv3: Volatile Organic Compound (VOC) content restrictions and other LEED requirements.
- B. Section 03 30 00 – Cast-in-Place Concrete.
- C. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.3 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- C. ASTM E 84-08a* – Standard Test Method for Surface Burning Characteristics of Building Materials (NFPA 255, ANSI/UL 723 & UBC 8-1)
- D. ASTM C 1028-07 – Static Coefficient of Friction
- E. ASTM E 2322-03 – Standard Test Method for Conducting Transverse and Concentrated Loads in Floor and Roof Construction

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Product Data: Manufacturer's data sheets on each product to be used.
- D. Samples: Submit actual samples, minimum 6 inches square, illustrating proposed material and finish.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience. Shop that employs skilled workers who custom-fabricate products similar to those required for their project and whose products have a record of successful in-service performance.
 - 1. Fabricator of this section must also provide work specified in Division 12 Section "Countertops."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect all delivered materials to ensure they are undamaged and in good condition.
- B. Store and dispose of solvent-based materials, such as construction adhesive and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 WARRANTY

- A. At project closeout and upon request, Bison Innovative Products can provide to the Owner or Owners Representative an executed copy of the Manufacturer's standard document outlining the terms, conditions, and limitations of their limited warranty against manufacturing defect for a period of five (5) years.
- B. The Contractor warrants that his work will remain free from defects of labor and materials used in conjunction with his work in accordance with the General Conditions for this project or a maximum of five (5) years.
- C. It is the responsibility of the Contractor installing the product listed in this section to coordinate warranty requirements with any related sections or adjacent work. Notify the Architect immediately of any potential lapses or limitations in warranty coverage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Wood Tile Manufacturer:
 - 1. Bison Innovative Products, www.bisonip.com

- 1 2. Architrex Inc., www.architrex.com
- 2 3. Substitutions: See Section 01 6000 - Product Requirements.
- 3 B. Pedestal supports for Deck Tiles:
- 4 1. Same as Wood Tile Manufacturer.

2.2 WOOD-BASED COMPONENTS

- 6 A. Pre-Manufactured Wood Tiles
- 7 1. Smooth IPE Wood Tile
- 8 a. Dimensions: Nominal 24" x 24"
- 9 b. Weight per Tile: 22-26 lbs
- 10 c. Fire Rating: Class A
- 11 d. Wood Species: IPE (Sustainably sourced FSC Certification for all wood utilized)
- 12 e. Surface: Smooth
- 13 f. Finish: Provide penetrating oil finish with UV blocker.
- 14 g. Fastening: Fasten with mfr. supplied fasteners to pedestals.
- 15 h. Layout: Refer to drawings for wood tile location, configuration, and direction.

2.3 PEDESTAL SUPPORTS FOR DECK TILES

- 18 A. Adjustable Height Pedestal Supports
- 19 1. Adjustable Height screw-jack type support accommodating height adjustments as required and indicated on
- 20 drawings. Pedestal to include bearing plate with integral holes for mechanically fastening to substrate.
- 21 a. Load Capacity: 1,000 lbs minimum per pedestal
- 22 b. Material: High density Copolymer Polypropylene.
- 23 c. Spacers: Integral tab spacers.
- 24 d. Shims: Per mfr. standard for sloped substrate compensation. Include base levelers as required per mfr.
- 25 e. recommendation.

2.4 WOOD DECKING

- 28 A. Decking Boards
- 29 1. Smooth IPE Wood Decking
- 30 a. Dimensions: 5/4 x 6" decking boards in random lengths between support framing. No lengths less than 32".
- 31 b. Wood Species: IPE (Sustainably sourced FSC Certification for all wood utilized)
- 32 c. Surface: Smooth
- 33 d. Finish: Provide penetrating oil finish with UV blocker.
- 34 e. Fastening: Provide IPE hidden fastener installation. Route deck boards to accept hidden fasteners.
- 35 f. Layout: Refer to drawings for wood decking location, configuration, and direction.

PART 3 EXECUTION

3.1 EXAMINATION

- 40 A. Prior to installation verify the following:
- 41 1. All elevations and deck dimensions are correct.
- 42 2. Special features and anticipated live/dead loads on the Wood Tiles are compatible with the deck system.
- 43 3. Substrates have been properly prepared and the project is set to proceed.

3.2 INSTALLATION

- 46 A. Pedestal Supports for Deck Tiles
- 47 1. Set roof deck tile supports in locations coordinated with approved roof deck layout. Install in accordance with
- 48 support manufacturer's written instructions and approved submittals. Adjust roof deck tile support heights prior to,
- 49 and following, installation of roof deck tiles. Shim where fine adjustment is necessary using manufacturer-provided
- 50 shims.
- 51 2. Tolerances for Roof Deck Tile Supports:
- 52 a. Maximum of 1/16 inch height variation between adjacent roof deck tiles.
- 53 b. Maximum 3/16 inch spacing between each tile and at perimeter walls
- 54 c. Individual roof deck tiles shall not vary more than 1/16 inch from level across width of the tiles.
- 55 d. Tiled areas shall not vary more than 1/4 inch from level in a distance of 10 feet measured at any location and in
- 56 any direction.
- 57

- 1 B. Wood Tiles:
- 2 1. Install wood deck tiles according to manufacturer's written instructions and approved shop drawings. Set in place
- 3 using placement methods that result in stable installation free from rocking using sound wood deck tiles with no
- 4 surface damage. Make final in-place height adjustments using manufacturer's furnished tool.
- 5
- 6 **3.3 CLEANING**
- 7 A. Remove and replace loose or otherwise damaged wood deck tiles, or if tiles do not match adjoining units or pattern
- 8 indicated on Drawings.
- 9 B. Cleaning: Wash tiles with water or use a pressure washer on low setting (max 1200 PSI) to remove dust or dirt.
- 10
- 11 **END OF SECTION**

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SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Finish carpentry items.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 06 4216 - Wood-Veneer Paneling: Shop fabricated custom paneling.
- D. Section 08 1416 - Flush Wood Doors.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- D. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
- E. PS 1 - Structural Plywood; 2009.
- F. WDMA I.S. 4 - Industry Specification for Preservative Treatment for Millwork; 2013.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- C. Samples: Submit two samples of wood trim 12 inch long.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
- C. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: As indicated on drawings. Refer to Interior Finish Specification on A600.
 - 2. Window Sills: As indicated on drawings. Refer to Interior Finish Specification on A600.
 - 3. Suspended Wood Ceiling System: As indicated on drawings. Refer to Interior Finish Specification on A600.
 - 4. Interior Wall Veneer: Refer to Interior Finish Specification on A600..

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood, certified or labeled as specified in Section 01 6000 - Product Requirements.

2.3 LUMBER MATERIALS

- A. Wood Species: Type-WD-1, Refer to Interior Finish Specification on A600. System shall consist of Urban Ash Wood sourced directly through a certified Wisconsin Urban Wood Supplier. <http://wisconsinurbanwood.org/sawyers/>
 - 1. Raw lumber to be milled to specification and as indicated on drawings.
 - 2. Sourced Urban Ash shall be from the Pinney Library Neighborhood and greater Madison area to greatest extent possible.

- 1 3. Coordinate sourcing, sawing, drying, and milling between Wisconsin Urban Wood Supplier and final fabrication and
2 installer.
3 4. Finish: Wood finish shall utilize custom stain to match architects sample with satin sheen. Back of planks shall be
4 factory sealed.
5 5. Fire Rating: Panels shall achieve a Class A Fire Rating.
6

7 **2.4 SHEET MATERIALS**

- 8 A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as
9 recommended for application.
10

11 **2.5 FASTENINGS**

- 12 A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other
13 volatile organic compounds.
14 B. Fasteners: Of size, type, and finish to suit application.
15

16 **2.6 ACCESSORIES**

- 17 A. Lumber for Shimming and Blocking: Softwood lumber of pine species.
18 B. Wood Filler: Solvent base, tinted to match surface finish color.
19

20 **2.7 WOOD TREATMENT**

- 21 A. Factory-Treated Lumber: Comply with requirements of AWWPA U1 - Use Category System for pressure impregnated wood
22 treatments determined by use categories, expected service conditions, and specific applications.
23 B. Fire Retardant Treatment (FR-S Type): Chemically treated and pressure impregnated; capable of providing flame spread
24 index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
25 C. Wood Preservative by Pressure Treatment (PT Type): Provide AWWPA U1 treatment using waterborne preservative with
26 0.25 percent retainage.
27 D. Water Repellent Preservative Treatment by Dipping Method: WDMA I.S. 4, with 0.25 percent retainage.
28 E. Provide identification on fire retardant treated material.
29

30 **2.8 FABRICATION**

- 31 A. Shop assemble work for delivery to site, permitting passage through building openings.
32 B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and
33 site cutting.
34

35 **2.9 SHOP FINISHING**

- 36 A. Sand work smooth and set exposed nails and screws.
37 B. Apply wood filler in exposed nail and screw indentations.
38 C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended
39 for the applicable finish.
40 D. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified
41 and as follows:
42 1. Transparent:
43 a. System - 1, Lacquer, Nitrocellulose.
44 b. Stain: As selected by Architect.
45 c. Sheen: Flat.
46

47 **PART 3 EXECUTION**

48
49 **3.1 INSTALLATION**

- 50 A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
51 B. Set and secure materials and components in place, plumb and level.
52 C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to
53 conceal larger gaps.
54

55 **3.2 TOLERANCES**

- 56 A. Maximum Variation from True Position: 1/16 inch.

1 B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

2

3

4

END OF SECTION

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SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.
- C. Factory finishing.
- D. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

- A. Section 01 81 13 - Sustainable Design Requirements – LEEDv3: Volatile Organic Compound (VOC) content restrictions and other LEED requirements.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 12 36 00 - Countertops.

1.3 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience. Shop that employs skilled workers who custom-fabricate products similar to those required for their project and whose products have a record of successful in-service performance.
 - 1. Fabricator of this section must also provide work specified in Division 12 Section "Countertops."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.7 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets at all locations:
 - 1. Cabinet Design Series: As indicated on drawings.
 - 2. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - 3. Cabinet Style: Flush overlay.
 - 4. Cabinet Doors and Drawer Fronts: Flush style.
 - 5. Drawer Side Construction: Multiple-dovetailed.
 - 6. Drawer Construction Technique: Dovetail joints.

- 1
2 **2.2 WOOD-BASED COMPONENTS**
3 A. Wood fabricated from old growth timber is not permitted.
4
- 5 **2.3 LAMINATE MATERIALS**
6 A. Manufacturers:
7 1. Basis of Design: Wilsonart. Refer to Interior Finish Specification on A600.
8 B. Provide specific types as indicated.
9 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color. Refer to Interior Finish Specification on A600.
10 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color. Refer to Interior Finish Specification on A600.
11
- 12 **2.4 COUNTERTOPS**
13 A. Countertops are specified in Section 12 36 00.
14
- 15 **2.5 HEAVY DUTY SHELVING**
16 A. Heavy Duty Shelving is specified in Section 10 56 17 Wall Mounted Standards and Shelving.
17
- 18 **2.6 ACCESSORIES**
19 A. Adhesive: Type recommended by fabricator to suit application.
20 B. Provide additional scribed trim and fillers at top and sides of all cabinets as indicated on drawings of the same face finish to
21 fill all voids between casework and finished wall surface.
22
- 23 **2.7 HARDWARE**
24 A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
25 B. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated
26 cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
27 C. Drawer and Door Pulls:
28 1. Basis of Design: Richelieu, Contemporary Metal Pull 107, steel with brushed nickel finish, 4 inch centers: Product
29 BP1076195
30 D. Sliding Door Pulls: Circular shape for recessed installation, steel with satin finish.
31 E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with brushed nickel finish.
32 F. Catches: Magnetic.
33 G. Drawer Slides:
34 1. Type: Full extension.
35 2. Static Load Capacity: Heavy Duty grade.
36 3. Mounting: Side mounted.
37 4. Stops: Integral type.
38 5. Features: Provide self-closing/stay closed type.
39 H. Hinges: European style concealed self-closing type, steel with polished finish.
40 J. Counter Supports:
41 1. Basis of Design: Rakks EH-Surface Mount Counter Support Bracket.
42 a. Finish: Factory Primed, Field apply to match wall paint.
43 b. Size: Per manufacturer to support counter depth.
44 c. Spacing: Per manufacturer's guidelines and as indicated on elevations.
45 K. Vanity Supports:
46 1. Basis of Design: Rakks EHV-Vanity Support Bracket.
47 a. Finish: Mill aluminum
48 b. Size: Per manufacturer to support counter depth.
49 c. Spacing: Per manufacturer's guidelines and as indicated on elevations.
50
- 51 **2.8 FABRICATION**
52 A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building
53 openings.
54 B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
55 C. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners
56 and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from
57 sink cut-outs.

- 1 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- 2 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- 3 D. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- 4

5 **2.9 SHOP FINISHING**

- 6 A. Sand work smooth and set exposed nails and screws.
- 7 B. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified
- 8 and as follows:
- 9 1. Transparent:
- 10 a. System – 4, Latex Acrylic, Water-based
- 11 b. Stain: As selected by Architect.
- 12 c. Sheen: Flat.
- 13

14 **PART 3 EXECUTION**

15
16 **3.1 EXAMINATION**

- 17 A. Verify adequacy of backing and support framing.
- 18 B. Verify location and sizes of utility rough-in associated with work of this section.
- 19

20 **3.2 INSTALLATION**

- 21 A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- 22 B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- 23 C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- 24 D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim
- 25 for this purpose.
- 26 E. Secure cabinets to floor using appropriate angles and anchorages.
- 27

28 **3.3 ADJUSTING**

- 29 A. Adjust moving or operating parts to function smoothly and correctly.
- 30

31 **3.4 CLEANING**

- 32 A. Clean casework, counters, shelves, hardware, fittings, and fixtures.
- 33
- 34
- 35

END OF SECTION

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SECTION 06 42 00
LINEAR WOOD PANELING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Custom linear wood paneling.
- B. Shop finishing.

1.2 RELATED REQUIREMENTS

- A. Section 01 81 13 - Sustainable Design Requirements – LEEDv3: Volatile Organic Compound (VOC) content restrictions and other LEED requirements.
- B. Section 06 10 00 - Rough Carpentry: Grounds and concealed blocking.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2009.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on fire retardant treatment materials and application instructions.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- D. Samples: Submit two samples of finished paneling, 12" x 12" in size, illustrating wood grain and specified finish.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.6 MOCK-UP

- A. Construct mock-up, 12 feet long by 4 feet wide, illustrating full panel sheet, edge trim, joint trim, and applied finish.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).

PART 2 PRODUCTS

2.1 PANELING

- A. Quality Standard: Grades as indicated, in accordance AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Flat Paneling: Type: WD-1, Refer to Interior Finish Specification on A600.
 - 1. Wood Planks shall be provide in a size of 3-1/4", 5-1/4", and 7-1/4" wide x 1/2" thick.
 - 2. Wood plank shall be random lengths up to 10' for solid wood.
 - 3. Wood planks shall be installed with a routed 3/4"W x 3/8"D reveal as indicated on drawings. Linear wood members shall be 4", 6", and 8" module size (with the module size equal to wood plank width plus 3/4" reveal; 3-1/4" wide plank plus 3/4" reveal equals 4" module.
 - 3. Wood Species: Type-WD-1, Refer to Interior Finish Specification on A600. System shall consist of Urban Ash Wood sourced directly through a certified Wisconsin Urban Wood Supplier. <http://wisconsinurbanwood.org/sawyers/>
 - a. Raw lumber to be milled to specification and as indicated on drawings.
 - b. Sourced Urban Ash shall be from the Pinney Library Neighborhood and greater Madison area to greatest extent possible.
 - c. Coordinate sourcing, sawing, drying, and milling between Wisconsin Urban Wood Supplier and final fabrication and installer.

- 1 6. Finish: Wood finish shall utilize custom stain to match architects sample with satin sheen. Back of planks shall be
2 factory sealed.
3 7. Fire Rating: Panels shall achieve a Class A Fire Rating.
4

5 **2.2 WOOD-BASED MATERIALS - GENERAL**

- 6 A. Wood fabricated from old growth timber is not permitted.
7

8 **2.3 ADHESIVES AND FASTENERS**

- 9 A. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations.
10 B. Fasteners: Stainless Steel concealed finish nails on face of panels.
11

12 **2.4 FABRICATION**

- 13 A. Prepare panels for delivery to site, permitting passage through building openings.
14 B. Finish exposed edges of panels as specified by grade requirements.
15

16 **2.5 SHOP FINISHING**

- 17 A. Sand work smooth and set exposed nails and screws.
18 B. Apply wood filler in exposed nail and screw indentations.
19 C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified
20 and as follows:
21 1. System – 4, latex Acrylic, Water-based
22 2. Stain: As selected by Architect to match architect provided sample.
23 3. Sheen: Flat
24

25 **2.6 ACCESSORIES**

- 26 A. Lumber for Shimming and Blocking.
27

28 **PART 3 EXECUTION**

29 **3.1 EXAMINATION**

- 30 A. Verify that field measurements are as indicated on shop drawings.
31 B. Verify adequacy of backing and support framing.
32 C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.
33
34

35 **3.2 INSTALLATION**

- 36 A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
37 B. Do not begin installation until wood materials have been fully acclimated to interior conditions.
38 C. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.
39

40 **3.3 TOLERANCES**

- 41 A. Maximum Variation from True Position: 1/16 inch.
42 B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.
43
44
45

END OF SECTION

**SECTION 06 60 10
POLYMER RESIN FABRICATIONS**

PART 1 – GENERAL

1.1 SUMMARY

- A. This Section includes the Plastic Fabrication as shown and specified in the described system(s):
 - 1. Custom PlayLab window frame and cubby fabrications.

1.2 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.
- C. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.
 - 1. Test reports required are:
 - a. Rate of Burning (ASTM D 635)
 - b. Self-Ignition Temperature (ASTM D 1929)
 - c. Density of Smoke (ASTM D 2843)
 - d. Flame spread and Smoke developed testing (ASTM E 84)
 - e. Room Corner Burn Test (NFPA 286)
 - f. Extent of Burning (UL 94)
 - g. Impact strength (ASTM D 3763)
 - h. Safety glazing impact resistance (ANSI Z97.1-2004)
 - i. UPIIT Test for Combustion Product Toxicity
 - j. Dynamic environmental testing (ASTM standards D 5116 and D 6670)
- D. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.
- E. Samples:
 - 1. Submit minimum 4-inch by 4-inch sample for each type, texture, pattern and color of solid plastic fabrication.
- F. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.3 QUALITY ASSURANCE

- A. Manufacturers Qualifications
 - 1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least five (5) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been successful for use five (5) years or longer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective packaging.
- B. Do not deliver Plastic Fabrications, system, components and accessories to Project site until areas are ready for installation.
- C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.
- D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.
- E. Before installing Plastic Fabrications, permit them to reach room temperature.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install Solid Polymer Fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Lightblocks, Classic Acrylic: www.lightblocks.com

1 B. Substitutions: See Section 01 6000 - Product Requirements.

2 **2.2 MATERIALS**

3 A. Polymer Resin Fabrications: Type - AR-1: Subject to compliance with requirements provide the specified product or a
4 comparable product approved by the Architect prior to bid.

5 1. Products: Refer to Interior Finish Specificaiton on A600.

6 2. Engineered polyester resin

7 3. Thickness: As indicated on drawings

8 4. Edge treatment: Per manufactured recommendation

9 5. Forming: Thermoformed Panel w/ factory seams

10 6. Sheet minimum performance attributes:

11 a. Rate of Burning (ASTM D 635). Material must attain CC1 Rating for a nominal thickness of 1.5 mm (0.060 in.)
12 and greater.

13 b. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-ignition temperature greater than 650°F.

14 c. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 75%.

15 d. Flame spread and Smoke developed testing (ASTM E 84). Material must be able to meet a level of Class B
16 (Flame spread less than 75 and smoke less than 450) at thickness of 1".

17 e. Extent of Burning (UL 94). Must submit UL card.

18 f. Impact strength. Minimum impact strength test as measured by ASTM D 3763 of 20 ft. lbs. (for durability,
19 shipping, installation, and use).

20 g. Safety Glazing. Material must attain a Class A impact rating in accordance with ANSI Z97.1-2004 at 1/8"
21 thickness.

22 h. Dynamic environmental testing (ASTM standards D 5116 and D 6670). Panels must not have detectable VOC
23 off-gassing agents and must be have Greenguard Indoor Air Quality certified.

24 i. Panels must be produced from a minimum of 40% post-industrial recycle content. This recycle content must
25 be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).

26 7. Hardware:

27 a. Shelf Hardware: Concealed

28 1) Manufacturer to engineer, design, and provide all concealed brakets, supports, trim, anchors, screws,
29 blocking and any other required components to deliver product as shown on drawings.

30 8. Sealant: Provide VOC compliant, clear glazing sealants at joints.

31
32 **2.3 FABRICATION**

33 A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards.
34 Sizes, profiles and other characteristics are indicated on the drawings.

35 B. Comply with manufacturer's written recommendations for fabrication.

36 C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining
37 operations.

38 1. Sawing: Select equipment and blades suitable for type of cut required.

39 2. Drilling: Drills specifically designed for use with plastic products.

40 3. Milling: Climb cut where possible.

41 4. Routing

42 5. Tapping

43 D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's
44 written instructions.

45 1. Thermoforming

46
47 **2.4 MISCELLANEOUS MATERIALS**

48 A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of
49 compatibility with surfaces contacted in installation.

50 B. Cleaner: Type recommended by manufacturer.

51 C. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations.
52 Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.

53 D. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

54

1 **PART 3 – EXECUTION**

2
3 **3.1 EXAMINATION**

- 4 A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for
5 compliance with manufacturer’s requirements. Verify that substrates and conditions are satisfactory for installation and
6 comply with requirements specified.

7
8 **3.2 INSTALLATION**

- 9 A. General: Comply with manufacturer’s written instructions for the installation of Plastic Fabrications.
10 B. Manufacturer’s shop to fabricate items to the greatest degree possible.
11 C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material
12 that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
13 D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and
14 product data.
15 E. Form field joints using manufacturer’s recommended procedures. Locate seams in panels so that they are not directly in
16 line with seams in substrates.

17
18 **3.3 CLEANING AND PROTECTION**

- 19 A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot
20 be repaired to Architect’s satisfaction.

21
22 **END OF SECTION**

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SECTION 07 21 19
FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In exterior framed walls.
 - 2. In exterior wall crevices.
 - 3. At junctions of dissimilar wall and roof materials.

1.2 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- B. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
- C. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2014.
- D. ASTM D1623 - Standard Test Method for Tensile And Tensile Adhesion Properties of Rigid Cellular Plastics; 2017.
- E. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- H. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- I. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

1.3 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.
- D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- E. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- F. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience.
- C. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.5 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5 degrees F of dew point.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
 - 1. Regulatory Requirements: Conform to applicable code for flame and smoke, concealment, and overcoat limitations.
 - 2. Thermal Resistance: R-value of 5.0, minimum, per 1 inch thickness at 75 degrees F mean temperature when tested in accordance with ASTM C518.

- 1 3. Water Vapor Permeance: Vapor retarder; 2 perms, maximum, when tested at intended thickness in accordance with
- 2 ASTM E96/E96M, desiccant method.
- 3 4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
- 4 5. Air Permeance: 0.04 cfm/sq ft, maximum, when tested at intended thickness in accordance with ASTM E2178 or
- 5 ASTM E283 at 1.57 psf.
- 6 6. Closed Cell Content: At least 90 percent.
- 7 7. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in
- 8 accordance with ASTM E84.
- 9 8. Other Acceptable Manufacturers:
- 10 a. Accella Polyurethane Systems; EcoBay CC: www.baysealsprayfoam.com/architects/#sle.
- 11 b. BASF Corporation; WALLTITE US: www.spf.basf.com/#sle.
- 12 c. Demilec LLC; HEATLOK HFO High Lift: www.demilec.com/#sle.
- 13 d. Gaco Western; GacoOnePass F1850R: www.gaco.com/#sle.
- 14 e. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com/#sle.
- 15 9. Substitutions: See Section 01 6000 - Product Requirements.
- 16

17 **2.2 ACCESSORIES**

- 18 A. Primer: As required by insulation manufacturer.
- 19

20 **PART 3 EXECUTION**

21 **3.1 EXAMINATION**

- 22 A. Verify work within construction spaces or crevices is complete prior to insulation application.
- 23 B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.
- 24
- 25

26 **3.2 PREPARATION**

- 27 A. Mask and protect adjacent surfaces from over spray or dusting.
- 28 B. Apply primer in accordance with manufacturer's instructions.
- 29

30 **3.3 APPLICATION**

- 31 A. Apply insulation in accordance with manufacturer's instructions.
- 32 B. Apply insulation by spray method, to a uniform monolithic density without voids.
- 33 C. Apply to achieve a thermal resistance R-value of 22.5.
- 34 D. Patch damaged areas.
- 35 E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind
- 36 operable parts.
- 37 F. Trim excess away for applied trim or remove as required for continuous sealant bead.
- 38

39 **3.4 PROTECTION**

- 40 A. Do not permit subsequent construction work to disturb applied insulation.
- 41
- 42

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015.
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014b.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a (Reapproved 2015).
- F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015b, with Editorial Revision (2016).
- G. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).
- H. ITS (DIR) - Directory of Listed Products; current edition.
- I. FM 4991 - Approval Standard for Firestop Contractors; 2013.
- J. FM (AG) - FM Approval Guide; current edition.
- K. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- L. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- M. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- N. UL (FRD) - Fire Resistance Directory; current edition.

1.3 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Certificate from authority having jurisdiction indicating approval of materials used.
- H. Installer Qualification: Submit qualification statements for installing mechanics.

1.4 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - 2. Verification of minimum three years documented experience installing work of this type.
 - 3. Verification of at least five satisfactorily completed projects of comparable size and type.
 - 4. Licensed by local authorities having jurisdiction (AHJ).

1 **1.5 FIELD CONDITIONS**

- 2 A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation.
3 Maintain minimum temperature before, during, and for 3 days after installation of materials.
4 B. Provide ventilation in areas where solvent-cured materials are being installed.
5

6 **PART 2 PRODUCTS**

7
8 **2.1 MATERIALS**

- 9 A. Firestopping Materials: Any materials meeting requirements.
10 B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested
11 firestopping assembly.
12

13 **2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS**

- 14 A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E2307 to have fire
15 resistance F Rating equal to required fire rating of the floor assembly.
16 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
17 2. Temperature Rise: In addition, provide systems that have been tested to show T Rating as indicated.
18 B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal
19 Assemblies: Use any system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to
20 required fire rating of floor or wall, whichever is greater.
21 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
22 C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use any system that
23 has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the
24 assembly in which the joint occurs.
25 1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
26 2. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of
27 successful testing.
28

29 **2.3 FIRESTOPPING SYSTEMS**

- 30 A. Firestopping: Any material meeting requirements.
31 1. Fire Ratings: Use any system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM
32 E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal
33 to F Rating and in compliance with other specified requirements.
34

35 **PART 3 EXECUTION**

36
37 **3.1 EXAMINATION**

- 38 A. Verify openings are ready to receive the work of this section.
39

40 **3.2 PREPARATION**

- 41 A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of
42 firestopping material.
43 B. Remove incompatible materials that could adversely affect bond.
44

45 **3.3 INSTALLATION**

- 46 A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely
47 closing openings.
48 B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
49 C. Install labeling required by code.
50

51 **3.4 FIELD QUALITY CONTROL**

- 52 A. Independent Testing Agency: Inspection agency employed and paid by City of Madison, will examine penetration
53 firestopping in accordance with ASTM E2174, and ASTM E2393.
54 B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do
55 not meet specified requirements.
56

1 **3.5 CLEANING**
2 A. Clean adjacent surfaces of firestopping materials.
3

4 **3.6 PROTECTION**
5 A. Protect adjacent surfaces from damage by material installation.
6

7 **END OF SECTION**
8

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SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag joint sealants.
- B. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

- A. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2012 (Reapproved 2017).
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2008 (Reapproved 2012).
- F. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2014.
- G. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2013.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Sealant Schedule: Submit prepared schedule of all utilized sealants on project identifying joint locations, sealant type, size, and color.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - c. Other joints indicated below.
 - 2. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
 - 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.

2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
3. Sound-Rated Assemblies: Acrylic emulsion latex sealant.
- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, break rooms and areas adjacent to sinks; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.2 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: To match adjacent material. Color to be selected from manufacturer's full range of standard colors.
 2. Manufacturers:
 - a. Pecora Corporation; www.pecora.com.
 - b. Sika Corporation; Sikasil GP: www.usa-sika.com/#sle.
- C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Color: To match adjacent material. Color to be selected from manufacturer's full range of standard colors.
 3. Manufacturers:
 - a. Pecora Corporation; www.pecora.com.
 - b. The QUIKRETE Companies; QUIKRETE® Polyurethane Non-Sag Sealant: www.quikrete.com/#sle.
 - c. Sika Corporation; Sikaflex-1a: www.usa-sika.com/#sle.
 - d. Sika Corporation; Sikaflex-2c NS: www.usa-sika.com/#sle.
 - e. Tremco Commercial Sealants & Waterproofing; Vulkem 116: www.tremcosealants.com/#sle.

2.4 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

- 1 G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be
- 2 outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are
- 3 followed.
- 4 H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling
- 5 sealant surface.
- 6
- 7
- 8

END OF SECTION

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**SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hollow metal frames for wood doors.
- B. Fire-rated hollow metal frame for wood doors.
- C. Sound-rated hollow metal doors and frames.
- D. Hollow metal borrowed lites glazing frames.
- E. Accessories, including glazing and matching panels.

1.2 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 9123 - Interior Painting: Field painting.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015, with Editorial Revision (2016).
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- I. ITS (DIR) - Directory of Listed Products; current edition.
- J. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- K. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2006.
- L. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- M. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- N. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- O. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.
- P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

- 1 B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory
2 applied painted finish.
3

4 **PART 2 PRODUCTS**

5 **2.1 MANUFACTURERS**

- 6 A. Hollow Metal Doors and Frames:
7 1. Ceco Door, an Assa Abloy Group company; www.assaabloydss.com.
8 2. De La Fontaine Inc; Hollow Metal Door Model www.delafontaine.com/#sle.
9 3. Mesker, dormakaba Group; FDJ Series Drywall Frames: www.meskeropeningsgroup.com/#sle.
10 4. Republic Doors, an Allegion brand; www.republicdoor.com/#sle.
11 5. Steelcraft, an Allegion brand; www.allegion.com/#sle.
12 6. Substitutions: See Section 01 6000 - Product Requirements.

13 **2.2 DESIGN CRITERIA**

- 14 A. Requirements for Hollow Metal Doors and Frames:
15 1. Steel used for fabrication of doors and frames shall comply with one or more of the following requirements;
16 Galvanized steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-
17 rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
18 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
19 B. Hollow Metal Panels: Same construction, performance, and finish as doors.
20 C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of
21 requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as
22 being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two
23 requirements conflict, comply with the most stringent.
24

25 **2.3 HOLLOW METAL FRAMES**

- 26 A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door
27 frame requirements.
28 B. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
29 1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
30 2. Frame Finish: Factory primed and field finished. Refer to Door Schedule on A601 for final finish.
31 C. Door Frames, Fire-Rated: Full profile/continuously welded type.
32 1. Fire Rating: Same as door, labeled.
33 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
34 3. Frame Finish: Factory primed and field finished. Refer to Door Schedule on A601 for final finish.
35 D. Sound-Rated Door Frames: Knock-down type.
36 1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
37 2. Frame Finish: Factory primed and field finished. Refer to Door Schedule on A601 for final finish.
38 E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
39 F. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
40
41

42 **2.4 FINISHES**

- 43 A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
44

45 **2.5 ACCESSORIES**

- 46 A. Glazing: As specified in Section 08 8000.
47 B. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
48

49 **PART 3 EXECUTION**

50 **3.1 EXAMINATION**

- 51 A. Verify existing conditions before starting work.
52 B. Verify that opening sizes and tolerances are acceptable.
53 C. Verify that finished walls are in plane to ensure proper door alignment.
54
55

56 **3.2 INSTALLATION**

- 57 A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and
58 frame standards or custom guidelines indicated.

- 1 B. Install fire rated units in accordance with NFPA 80.
- 2 C. Coordinate frame anchor placement with wall construction.
- 3 D. Install door hardware as specified in Section 08 7100.
- 4 E. Comply with glazing installation requirements of Section 08 8000.
- 5 F. Coordinate installation of electrical connections to electrical hardware items.
- 6 G. Touch up damaged factory finishes.
- 7

8 **3.3 TOLERANCES**

- 9 A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom
- 10 guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- 11 B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.
- 12

13 **3.4 ADJUSTING**

- 14 A. Adjust for smooth and balanced door movement.
- 15

16 **3.5 SCHEDULE**

- 17 A. Refer to Door and Frame Schedule on the drawings.
- 18

19 **END OF SECTION**

20

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SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, and acoustical.

1.2 RELATED REQUIREMENTS

- A. Section 08 1213 - Hollow Metal Frames.
- B. Section 08 7100 - Door Hardware.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- D. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- G. ICC (IBC) - International Building Code; 2015.
- H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.
- I. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2012.
- J. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- K. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- L. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
- M. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2013.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Samples: Submit two samples of door veneer, 8" by 10" in size illustrating wood grain, stain color, and sheen.
- E. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- F. Warranty, executed in City of Madison's name.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

1 **PART 2 PRODUCTS**

2
3 **2.1 MANUFACTURERS**

- 4 A. Wood Veneer Faced Doors:
- 5 1. Eggers Industries; Sketchface: www.eggersindustries.com.
 - 6 2. Marshfield DoorSystems, Inc; Signature Series: www.marshfielddoors.com.
 - 7 3. VT Industries; Heritage Collection: <http://www.vtindustries.com/>.
 - 8 4. Substitutions: See Section 01 6000 - Product Requirements.

9
10 **2.2 DOORS AND PANELS**

- 11 A. Doors: Refer to drawings for locations and additional requirements.
- 12 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or
 - 13 AWMAC/WI (NAAWS), unless noted otherwise.
 - 14 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- 15 B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
- 16 1. Provide solid core doors at each location.
 - 17 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure;
 - 18 Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is
 - 19 open.
 - 20 3. Sound-Rated Doors: Minimum STC of 45, calculated in accordance with ASTM E413, tested in accordance with ASTM
 - 21 E90.

22
23 **2.3 DOOR AND PANEL CORES**

- 24 A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- 25 B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core
- 26 blocking as required to provide adequate anchorage of hardware without through-bolting.
- 27 C. Sound-Rated Doors: Equivalent to type, with particleboard core (PC) construction as required to achieve STC rating
- 28 specified; plies and faces as indicated above.

29
30 **2.4 DOOR FACINGS**

- 31 A. Veneer Facing for Transparent Finish: Ash, veneer grade in accordance with quality standard indicated, plain sliced (flat
- 32 cut), with book match between leaves of veneer, balance match of spliced veneer leaves assembled on door or panel face.
- 33 1. Vertical Edges: Any option allowed by quality standard for grade.
 - 34 2. Refer to Interior Finish Specification on A600 and Door Schedule on A601.

35
36 **2.5 DOOR CONSTRUCTION**

- 37 A. Fabricate doors in accordance with door quality standard specified.
- 38 B. Cores Constructed with stiles and rails:
- 39 C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements
- 40 and dimensions.
- 41 D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with
- 42 specified quality standard.
- 43 E. Provide edge clearances in accordance with the quality standard specified.

44
45 **2.6 FACTORY FINISHING - WOOD VENEER DOORS**

- 46 A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified
- 47 and as follows:
- 48 1. Transparent:
 - 49 a. System - 12, Polyurethane, Water-based.
 - 50 b. Stain: As selected by Architect.
 - 51 c. Sheen: Satin.
 - 52 B. Factory finish doors in accordance with approved sample.

53
54 **2.7 ACCESSORIES**

- 55 A. Hollow Metal Door Frames: As specified in Section 08 1113.
- 56 B. Glazed Openings:
- 57 1. Heat-Strengthened and Fully Tempered Glass: ASTM C1048.
 - 58 2. Tint: Clear.

- 1 C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- 2 D. Door Hardware: As specified in Section 08 7100.

3
4 **PART 3 EXECUTION**

5 **3.1 EXAMINATION**

- 6 A. Verify existing conditions before starting work.
- 7 B. Verify that opening sizes and tolerances are acceptable.
- 8 C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

9
10 **3.2 INSTALLATION**

- 11 A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 12 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- 13 B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- 14 C. Field-Finished Doors: Trimming to fit is acceptable.
 - 15 1. Adjusting width of doors is not permitted.
 - 16 2. Trim maximum of 3/4 inch off bottom edges to achieve undercut specified in door schedule.
 - 17 3. Trim fire-rated doors in strict compliance with fire rating limitations.
- 18 D. Use machine tools to cut or drill for hardware.
- 19 E. Coordinate installation of doors with installation of frames and hardware.
- 20 F. Coordinate installation of glazing.

21
22 **3.3 TOLERANCES**

- 23 A. Conform to specified quality standard for fit and clearance tolerances.
- 24 B. Conform to specified quality standard for telegraphing, warp, and squareness.

25
26 **3.4 ADJUSTING**

- 27 A. Adjust doors for smooth and balanced door movement.
- 28 B. Adjust closers for full closure.

29
30 **END OF SECTION**
31

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SECTION 08 42 29
AUTOMATIC ENTRANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Packaged power-operated door assemblies of following types:
 - 1. Automatic Sliding type.
- B. Operators for automatic doors.
- C. Controllers, actuators and safety devices.

1.2 RELATED REQUIREMENTS

- A. Section 26 0583 - Wiring Connections.
- B. Section 28 1000 - Access Control: Connection to access control system; access control devices used as actuators.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- C. BHMA A156.10 - American National Standard for Power Operated Pedestrian Doors; 2017.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 101 - Life Safety Code; 2015.
- F. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
 - 2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.
- C. Product Data: Provide data on system components, sizes, features, and finishes.
- D. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- E. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in City of Madison's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience, and a member of AAADM.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
 - 1. Certified by AAADM.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fine Frame Sliding Automatic Entrance Door Assemblies:
 - 1. ASSA ABLOY Entrance Solutions; Besam SL500, Fine Frame Automatic Sliding Door: www.besam-usa.com.
 - 2. DORMA USA, Inc; ESA400, Fine Frame Automatic Sliding Door: www.dorma.com.

- 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 POWER OPERATED DOORS

- A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
 - 1. Sliding and Folding Door Operators: In the event of power failure, provide for manual open, close, and break-away operation of door leaves.
 - 2. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
 - a. Finish exposed equipment components to match door and frame finish.
- B. Sliding and Folding Doors with Full Power Operators: Comply with BHMA A156.10; safeties required; provide break-away operation unless otherwise indicated; in the event of break-away operation, interrupt power operation.
 - 1. Force Required to Swing Break-Away Panel: 50 pound-force, maximum, measured at 1 inch from the latch edge of the door at any point in the closing cycle.

2.3 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. Comply with ADA Standards for egress requirements.
- B. Framing and Transom Members: Provide manufacturer's standard extruded aluminum framing, reinforced as required to support imposed loads.
 - 1. Nominal Sizes:
 - a. Single Slide and Bi-Parting Sliding Doors: 1-3/4 inch wide by 4-1/2 inch deep.
- C. Fine Frame Sliding Automatic Door, Single leaf track-mounted, electric operation, all-glass door with extruded aluminum top and bottom rails and operator concealed overhead.
 - 1. Operation: Power open, power close operation.
 - 2. Exterior-Side Actuator/Safety: Motion sensor.
 - 3. Interior-Side Actuator/Safety: Motion sensor.
 - 4. Hold Open: Toggle switch at inside head of doors; this is not a fire-rated door.
 - 5. Rail and Frame Finish: Anodized, as indicated on door schedule.
 - 6. Locking mechanism and keying to match master key or grand master key locks to Owner's existing Sargent RB system.

2.4 CONTROLLERS, ACTUATORS, AND SAFETIES

- A. Controller: Provide microprocessor operated controller for each door.
- B. Comply with BHMA A156.10 for actuator and safety types and zones.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify that electric power is available and is of the correct characteristics.

3.2 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.

3.3 ADJUSTING

- A. Adjust door equipment for correct function and smooth operation.

3.4 CLEANING

- A. Remove temporary protection, clean exposed surfaces.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

END OF SECTION

SECTION 08 71 00
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
1. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Sliding D
 2. Cylinders for door hardware specified in other Sections.
 3. Electrified door hardware.

1.2 ACTION SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: For each type of product indicated.
- C. Pre-Procurement/Installation Meeting Requirement:
1. After submission of all door/frame/hardware submittals (and related low voltage door hardware submittals) Contractor will organize a meeting(s) with Owner, Architect, General Contractor, Electrician, Door/Frame/Hardware Supplier/Installer, Low-Voltage Supplier/Installer, and others as applicable to comprehensively review and explain each door opening's submitted hardware package operation. No procurement of door hardware (and related low voltage components) shall be procured until this meeting is completed; and until related submittals are returned to by the Owner/Architect team.
- D. Shop Drawings: Details of electrified door hardware.
- E. Samples: For each exposed product and for each color and texture specified.
- F. Other Action Submittals:
1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - b. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.3 QUALITY ASSURANCE

- A. Supplier Qualifications: The hardware supplier shall be a corporate member in good standing of The Door and Hardware Institute (DHI), employing at least one Architectural Hardware Consultant (AHC) who is currently participating in DHI's continuing education program (CEP).
- B. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated. Provide positive latching and self-closing, regardless if specified in sets.
- D. Items of hardware not definitely specified herein but necessary for completion of the work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable

- 1 types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate
2 for the service required.
- 3 E. Include such nuances as strike type, strike lip length, raised barrel hinges, mounting brackets, blade stop spacers,
4 special templates, fasteners, shims, and coordination between conflicting products. All doors shall be provided with
5 a stop.
- 6 F. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide
7 door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with
8 NFPA 105.
- 9 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure
10 differential of 0.3-inch wg (75 Pa) of water.
- 11 G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to
12 authorities having jurisdiction.
- 13 H. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use
14 of a key, tool, or special knowledge for operation.
- 15 I. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC/ANSI A117.1.
- 16 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that
17 operate with a force of not more than 5 lbf (22.2 N).
- 18 2. Comply with the following maximum opening-force requirements:
- 19 a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
- 20 b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- 21 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13
22 mm) high.
- 23 J. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project
24 Management and Coordination."
25

26 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 27 A. Deliver keys to Owner by registered mail or overnight package service.
28

29 **1.5 WARRANTY**

- 30 A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of
31 door hardware that fail in materials or workmanship within specified warranty period.
- 32 1. Warranty Period: 1 year from date of Substantial Completion, unless otherwise indicated.
33
- 34 a. Manual Closers: 25 years from date of Substantial Completion.
35

36 **PART 2 - PRODUCTS**

37 **2.1 SCHEDULED DOOR HARDWARE**

- 38 A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with
39 requirements in this Section.
- 40 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers'
41 products.
- 42 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface
43 with other building control systems indicated.
- 44 B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of
45 door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door
46 hardware designations, as follows:
- 47 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware
48 type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated
49 in Part 3 "Door Hardware Schedule" Article.
50

51 **2.2 CONTINUOUS HINGES**

- 52 A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width
53 of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components
54 finished after milling and drilling are complete.
- 55 B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-
56 aluminum channel cap; with concealed, self-lubricating thrust bearings.
57

- 1 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2
3 a. Hager Companies.
4 b. McKinney Products Company; an ASSA ABLOY Group company.
5 c. Select Products Limited.
6
- 7 **2.3 MECHANICAL LOCKS AND LATCHES**
- 8 A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated
9 for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or
10 latch.
11 B. Lever trim: Lever trim to be determined. Price is to be based on Sargent's Studio collection with Rose trim (not
12 including Gramercy, Wooster Square, or Grant Park designs).
13 C. Mortise Locks: BHMA A156.13; Grade 1; Series 1000.
14 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
15
16 a. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
17
- 18 **2.4 AUXILIARY LOCKS**
- 19 A. Narrow Stile Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame.
20 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
21
22 a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
23
- 24 **2.5 ELECTRIC STRIKES**
- 25 A. Electric Strikes: BHMA A156.31; Grade 1.
26 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
27 a. HES.
28 b. Security Door Controls.
29 c. Von Duprin.
30
- 31 **2.6 MANUAL FLUSH BOLTS**
- 32 A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
33 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
34
35 a. Door Controls International, Inc.
36 b. Hager Companies.
37 c. Rockwood Manufacturing Company.
38 d. Trimco.
39
- 40 **2.7 EXIT DEVICES**
- 41 A. Exit Devices and Auxiliary Items: BHMA A156.3.
42 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
43
44 a. Corbin Russwin Architectural Hardware.
45 b. SARGENT Manufacturing Company.
46
- 47 **2.8 LOCK CYLINDERS**
- 48 A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide
49 interchangeable core cylinders.
50
51 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
52
53 a. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
54 B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder
55 removal. Provide 10 construction master keys.
56 C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction
57 master keys.

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2.9 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
 - 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing Sargent RB system.
- B. Keys: Brass.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Control Keys: Two.

2.10 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Rockwood Manufacturing Company.
 - c. Trimco.

2.11 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.12 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Corbin Russwin Architectural Hardware.
 - b. Norton Door Controls.
 - c. SARGENT Manufacturing Company.
 - d. Yale Security Inc.

2.13 AUTOMATIC OPERATORS

- A. Automatic Operators: BHMA A156.19
 - 1. Available Manufacturers:
 - a. Stanley Magic Force (STA).

2.14 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass base metal.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Rockwood Manufacturing Company.

- 1 c. Trimco.
2
- 3 **2.15 OVERHEAD STOPS AND HOLDERS**
4 A. Overhead Stops and Holders: BHMA A156.8.
5 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
6 a. Rixson.
7 b. Rockwood Manufacturing Company.
8 c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- 9 **2.16 DOOR GASKETING**
10 A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length
11 for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips
12 that are easily replaceable and readily available from stocks maintained by manufacturer.
13 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
14 a. Hager Companies.
15 b. National Guard Products.
16 c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
17 d. Reese Enterprises, Inc.
- 18
19 **2.17 THRESHOLDS**
20 A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
21 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
22 a. Hager Companies.
23 b. National Guard Products.
24 c. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
25 d. Reese Enterprises, Inc.
- 26
27 **2.18 METAL PROTECTIVE TRIM UNITS**
28 A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with
29 manufacturer's standard machine or self-tapping screw fasteners.
30 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
31
32 a. Hager Companies
33 b. Rockwood Manufacturing Company.
34 c. Trimco.
- 35
36 **2.19 AUXILIARY DOOR HARDWARE**
37 A. Auxiliary Hardware: BHMA A156.16.
38 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
39
40 a. Hager Companies.
41 b. Rockwood Manufacturing Company.
42 c. Trimco.
- 43
44 **2.20 FABRICATION**
45 A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood,
46 and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application
47 intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to
48 match surface of door hardware, unless otherwise indicated.
49 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already
50 specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on
51 opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through
52 bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
53 2. Fire-Rated Applications:
54 a. Wood or Machine Screws: For the following:
55 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors
56 and frames.
57 2) Strike plates to frames.

- 1 3) Closers to doors and frames.
- 2 b. Steel Through Bolts: For the following unless door blocking is provided:
- 3 1) Surface hinges to doors.
- 4 2) Closers to doors and frames.
- 5 3) Surface-mounted exit devices.
- 6 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
- 7 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood
- 8 Doors."
- 9 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.21 FINISHES

- 12 A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- 13 B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective
- 14 covering before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- 19 A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to
- 20 ANSI/SDI A250.6.
- 21 B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood
- 22 Flush Doors."
- 23 C. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated
- 24 or required to comply with governing regulations.
- 25 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
- 26 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- 27 D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are
- 28 required to install door hardware onto or into surfaces that are later to be painted or finished in another way,
- 29 coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install
- 30 surface-mounted items until finishes have been completed on substrates involved.
- 31 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary
- 32 for proper installation and operation.
- 33 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and
- 34 anchors according to industry standards.
- 35 E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number
- 36 recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height,
- 37 whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are
- 38 provided.
- 39 F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with
- 40 requirements specified in Section 079200 "Joint Sealants."
- 41 G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not
- 42 mount floor stops where they will impede traffic.
- 43 H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- 44 I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- 45 J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.
- 46 K. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or
- 47 function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to
- 48 compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility
- 49 requirements.

3.2 DOOR HARDWARE SCHEDULE

HARDWARE SET 01

54	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
55	1	EA	CLASSROOM	63-8237	626	SAR
56	1	EA	CLOSER	351 X PSH	689	SAR
57	1	EA	KICK PLATE	10" X 2" LDW	630	ROC

1	1	SET	SEALS	5050C	BLK	NGP
2	1	EA	AUTO DR BOTTOM	423N	AL	NGP

3
4 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.
5
6

7 **HARDWARE SET 02**

8 HARDWARE BY DOOR SUPPLIER.
9

10 ****INCLUDE ADA COMPLIANT HOLD OPEN AT 113 (KICK DOWN STOPS ARE NOT ACCEPTABLE).**

11 **HARDWARE SET 03**

12	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
13	1	EA	PASSAGE	8215	626	SAR
14	1	EA	CLOSER W/HOLD	351 X H	689	SAR
15	1	EA	WALL STOP	409	630	ROC
16	1	EA	KICKPLATE	10" X 2" LDW	630	ROC

17
18 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.
19
20

21 **HARDWARE SET 04**

22	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
23	1	EA	CLASSROOM	63-8237	626	SAR
24	1	EA	WALL STOP	409	630	ROC
25	1	EA	KICKPLATE	10" X 2" LDW	630	ROC

26
27 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.
28
29

30 **HARDWARE SET 05**

31	1	EA	CYLINDER	AS REQUIRED	624	SAR
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32
33 ****BALANCE OF HARDWARE BY DOOR SUPPLIER (PANIC HARDWARE REQUIRED AT COMMUNITY ROOM DOORS). INCLUDE**
34 **CARD READER ACCESS AT DOORS: 109, 110, 111, AND 112.**
35
36

37 **HARDWARE SET 06**

38	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
39	1	EA	CLASSROOM	63-8237	626	SAR
40	1	EA	OVERHEAD STOP	10 SERIES	630	RIX

41
42
43 **HARDWARE SET 07**

44	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
45	1	EA	PRIVACY	49-8265	626	SAR
46	1	EA	CLOSER	351	689	SAR
47	1	EA	WALL STOP	409	630	ROC
48	1	EA	KICKPLATE	10" X 2" LDW	630	ROC

49
50 ****ALLOW 180 DEGREE SWING WHERE APPLICABLE**
51
52

53 **HARDWARE SET 08**

54	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
55	1	EA	PRIVACY	49-8265	626	SAR
56	1	EA	CLOSER	351	689	SAR
57	1	EA	OVERHEAD STOP	1 SERIES	630	RIX

1	1	EA	KICKPLATE	10" X 2" LDW	630	ROC
2						
3			<u>KICK PLATE DESCRIPTION:</u> Refer to door elevation on A601 for kick plate size and location.			
4						
5						
6						
7			<u>HARDWARE SET 09</u>			
8	1	EA	BIPARTING TRACK	SIM200A	AL	PEMKO
9	5	EA	SIDE WALL BRACKET	281	---	PEMKO
10	1	EA	FASCIA	F134C	AL	PEMKO
11	1	EA	END PLATE	K134EP	AL	PEMKO
12	2	EA	PULL	RM753-4"	630	ROCKWOOD

13
 14 **REFER TO ARCHITECTURAL DRAWINGS FOR LENGTH OF FASCIA TO BE EXTENDED OVER OPENING

15						
16						
17			<u>HARDWARE SET 10</u>			
18	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
19	1	EA	STOREROOM	63-8204	626	SAR
20	1	EA	CLOSER	351	689	SAR
21	1	EA	WALL STOP	409	626	ROC
22	1	EA	ELECTRIC STRIKE	6211	630	VON
23	1	EA	KICK PLATE	10" X 2" LD	630	ROC
24	1	EA	CARD READER	BY SECURITY CONTRACTOR		

25
 26 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked
 27 upon loss of power. Free egress at all times.

28
 29 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

30						
31						
32			<u>HARDWARE SET 11</u>			
33	1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
34	1	EA	CLASSROOM	63-8237	626	SAR
35	1	EA	CLOSER	351	689	SAR
36	1	EA	WALL STOP	409	626	ROC
37	1	EA	KICK PLATE	10" X 2" LDW	630	ROC

38						
39						
40			<u>HARDWARE SET 12</u>			
41	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
42	1	EA	PASSAGE	8215	626	SAR
43	1	EA	AUTO OPERATOR	9540	689	LCN
44	2	EA	WAVE ACTUATOR	8310-813	630	LCN
45	2	EA	FLUSH MOUNT BOX	8310-867F	---	LCN
46	1	EA	WALL STOP	403	626	ROC
47	1	EA	ELECTRIC STRIKE	6211	630	VON
48	1	EA	ARMOR PLATE	34" X 2" LDW	630	ROC

49
 50 ARMOR PLATE DESCRIPTION: Refer to door elevation on A601 for armor plate size and location.

51						
52						
53			<u>HARDWARE SET 13</u>			
54	1	EA	CONTINUOUS HINGE	BY OTHERS		
55	1	EA	EXIT DEVICE	AD8504 X ET*	630	SAR
56	1	EA	CYLINDER	AS REQUIRED	626	SAR
57	1	EA	AUTO OPERATOR	9540	689	LCN

1	1	EA	ACTUATOR	8310-856T	630	LCN
2	1	EA	FLUSH MOUNT BOX	8310-868F	---	LCN
3	1	EA	JAMB ACTUATOR	8310-818T	630	LCN
4	1	EA	FLUSH MOUNT BOX	8310-819F		
5	1	EA	STOP	BY OTHERS		
6	1	EA	SWEEP	BY OTHERS		
7	1	EA	THRESHOLD	BY OTHERS		
8	1	EA	ELECTRIC STRIKE	6300	630	VON
9	1	EA	POSITION SWITCH	1078	GRY	GE
10	1	EA	CARD READER	BY SECURITY CONTRACTOR		
11	1	EA	REQUEST TO EXIT	BY SECURITY CONTRACTOR		

12

13 **PROVIDE LEVER TRIM TO MATCH LEVERS USED INSIDE BUILDING.

14

15 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked
16 upon loss of power. Free egress at all times.

17

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19 **HARDWARE SET 14**

20	1	EA	EXIT DEVICE	10xW-01	630	DET
21	1	EA	GATE PLATE	GTPL	630	DET
22	1	EA	STRIKE BRACKET	GTSTKBKT	630	DET
23	1	EA	LATCH PROTECTOR	GTPLGRD	630	DET
24	1	EA	GATE CLOSER	1350	BLK	RIX
25	1	EA	POSITION SWITCH	2500 SERIES	AL	GE
26	1	EA	MNTG BRACKET	1094A	AL	GE
27	1	EA	REQUEST TO EXIT	BY SECURITY CONTRACTOR		

28

29 **BALANCE OF HARDWARE BY GATE DOOR SUPPLIER.

30 **COORDINATE DETEX GATE PLATE REQUIREMENTS WITH GATE DOOR SUPPLIER.

31

32

33 **HARDWARE SET 15**

34 NOT USED

35

36

37 **HARDWARE SET 16**

38	1	EA	CONTINUOUS HINGE	BY OTHERS		
39	1	EA	EXIT DEVICE	AD8504 X ET*	630	SAR
40	1	EA	CYLINDER	AS REQUIRED	626	SAR
41	1	EA	CLOSER	BY OTHERS		
42	1	EA	STOP	BY OTHERS		
43	1	EA	SWEEP	BY OTHERS		
44	1	EA	THRESHOLD	BY OTHERS		
45	1	EA	ELECTRIC STRIKE	6300	630	VON
46	1	EA	CARD READER	BY SECURITY CONTRACTOR		

47

48 **PROVIDE LEVER TRIM TO MATCH LEVERS USED INSIDE BUILDING.

49

50 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked
51 upon loss of power. Free egress at all times.

52

53

54 **HARDWARE SET 17**

55	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
56	1	EA	STOREROOM	63-8204	626	SAR
57	1	EA	AUTO OPERATOR	9540	689	LCN

1	1	EA	WAVE ACTUATOR	8310-813	630	LCN
2	1	EA	FLUSH MOUNT BOX	8310-867F	---	LCN
3	1	EA	ELECTRIC STRIKE	6211	630	VON
4	1	EA	ARMOR PLATE	34" X 2" LDW	630	ROC
5	1	EA	CARD READER	BY SECURITY CONTRACTOR		

6
7 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential releases electric strike and activates automatic
8 operator to allow entry. Inside wave actuator activates electric strike and automatic operator for egress. Door remains closed
9 and locked upon loss of power. Free egress at all times.

10
11 ARMOR PLATE DESCRIPTION: Refer to door elevation on A601 for armor plate size and location.

12
13
14 **HARDWARE SET 18**

15	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
16	1	EA	EXIT DEVICE	63-8804 X ET*	630	SAR
17	1	EA	CLOSER	351	689	SAR
18	1	EA	OVERHEAD HOLDER	1 SERIES	630	RIX
19	1	EA	ELECTRIC STRIKE	6300	630	VON
20	1	EA	KICK PLATE	10" X 2" LDW	630	ROC
21	1	EA	CARD READER	BY SECURITY CONTRACTOR		

22
23 **PROVIDE LEVER TRIM TO MATCH LOCK TRIM.

24
25 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked
26 upon loss of power. Free egress at all times.

27
28 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

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31 **HARDWARE SET 19**

32	2	EA	CONTINUOUS HINGE	780-224HD	628	HAG
33	2	EA	EXIT DEVICE	63-NB8706 X ET*	630	SAR
34	2	EA	CLOSER	351	689	SAR
35	2	EA	OVERHEAD HOLDER	1 SERIES	630	RIX
36	2	EA	KICK PLATE	10" X 1" LDW	630	ROC

37
38 **PROVIDE LEVER TRIM TO MATCH LOCK TRIM.

39
40 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

41
42
43 **HARDWARE SET 20**

44	1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
45	1	EA	EXIT DEVICE	63-8804 X ET*	630	SAR
46	1	EA	AUTO OPERATOR	9540	689	LCN
47	2	EA	WAVE ACTUATOR	8310-813	630	LCN
48	2	EA	FLUSH MOUNT BOX	8310-867F	---	LCN
49	1	EA	KEY SWITCH	8310-806K	BLK	LCN
50	1	EA	WALL STOP	403	626	ROC
51	1	EA	ELECTRIC STRIKE	6300	630	VON
52	1	EA	KICK PLATE	10" X 2" LDW	630	ROC
53	1	EA	CARD READER	BY SECURITY CONTRACTOR		

54
55 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential releases electric strike and also activates out-
56 side automatic operator actuator to allow entry. Inside wave actuator activates electric strike and automatic operator for
57 egress. Door remains closed and locked upon loss of power. Free egress at all times.

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KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

HARDWARE SET 21

1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
1	EA	STOREROOM	63-8204	626	SAR
1	EA	WALL STOP	409	630	ROC
1	EA	KICKPLATE	10" X 2" LDW	630	ROC

**ALLOW 180 DEGREE SWING.

KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

HARDWARE SET 22

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	STOREROOM	63-8204	626	SAR
1	EA	AUTO OPERATOR	9530	689	LCN
2	EA	WAVE ACTUATOR	8310-813	630	LCN
2	EA	FLUSH MOUNT BOX	8310-867F	---	LCN
1	EA	WALL STOP	403	626	ROC
1	EA	ELECTRIC STRIKE	6211	630	VON
1	EA	ARMOR PLATE	34" X 2" LDW	630	ROC
1	EA	POSITION SWITCH	1078	GRY	GE
1	EA	CARD READER	BY SECURITY CONTRACTOR		
1	EA	MOTION SENSOR	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential releases electric strike and also activates outside automatic operator actuator to allow entry. Inside wave actuator activates electric strike and automatic operator for egress. Door remains closed and locked upon loss of power. Free egress at all times.

ARMOR PLATE DESCRIPTION: Refer to door elevation on A601 for armor plate size and location.

HARDWARE SET 23

1	EA	CONTINUOUS HINGE	780-224HD	628	HAG
1	EA	STOREROOM	63-8204	626	SAR
1	EA	CLOSER W/HOLD	351 X H	689	SAR
1	EA	WALL STOP	409	626	ROC
1	EA	ELECTRIC STRIKE	6211	630	VON
1	EA	KICK PLATE	10" X 2" LDW	630	ROC
1	EA	POSITION SWITCH	1078	GRY	GE
1	EA	CARD READER	BY SECURITY CONTRACTOR		

OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked upon loss of power. Free egress at all times.

KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

HARDWARE SET 24

1	EA	CONTINUOUS HINGE	780-224HD	CLR	HAG
1	EA	STOREROOM DEADBOLT	50-8251	626	SAR
1	EA	CLOSER	351	689	SAR
1	EA	WALL STOP	409	626	ROC
1	EA	ELECTRIC STRIKE	55-D	630	SDC

1 1 EA KICKPLATE 10" X 2" LDW 630 ROC
2 1 EA CARD READER BY SECURITY CONTRACTOR

3

4 **WHEN DEADBOLT THROWN, CARD READER WILL NOT OPEN DOOR.

5

6 OPERATIONAL DESCRIPTION: Door normally closed and locked. Valid credential allows entry. Door remains closed and locked
7 upon loss of power. Free egress at all times.

8

9 KICK PLATE DESCRIPTION: Refer to door elevation on A601 for kick plate size and location.

10

11

12

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glazing units.
- B. Vinyl Films.
- C. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- B. Section 08 1416 – Flush Wood Doors: Glazed lites in doors and borrowed lites.
- C. Section 08 4229 - Automatic Entrances: Glazing furnished as part of door assembly.
- D. Section 10 2229 – Full Height Glazed Partitions: Glazed panels.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014a.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- G. GANA (GM) - GANA Glazing Manual; 2009.
- H. GANA (SM) - GANA Sealant Manual; 2008.
- I. GANA (LGRM) - Laminated Glazing Reference Manual; 2009.
- J. ICC (IBC) - International Building Code; 2015.
- K. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2004).
- L. ITS (DIR) - Directory of Listed Products; current edition.
- M. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Samples: Submit two samples 12" by 12" inch in size of glass units.
- D. Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in City of Madison's name and registered with manufacturer.
- F. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.6 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.

1 **PART 2 PRODUCTS**

2
3 **2.1 GLASS MATERIALS**

- 4 A. Float Glass: Provide float glass based glazing unless noted otherwise.
5 1. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and FT.
6 2. Fully Tempered Safety Glass: Complies with ANSI Z97.1 and 16 CFR 1201 criteria.
7 3. Thicknesses: As indicated; provide greater thickness as required.
8

9 **2.2 GLAZING UNITS**

- 10 A. GL-1 - Monolithic Interior Vision Glazing:
11 1. Applications: Interior glazing unless otherwise indicated.
12 2. Glass Type: Fully tempered float glass.
13 3. Tint: Clear.
14 4. Thickness: 3/8 inch, nominal.
15

16 **2.3 VINYL FILMS**

- 17 A. Type VF-1 - Decorative Vinyl Film: Glass and plastic finishes field-applied application to glass or plastic material as visual
18 opaque or decorative film.
19 1. Application: Locations as indicated on drawings.
20 2. Manufacturer: 3M Company
21 3. Decorative Pattern: Printed: To be selected from 3M's full range of Fasara- Decorative/Privacy Glazing Film glass
22 finishes. Refer to Interior Finish Specification on A600 for additional information.
23 4. Color: Translucent/White
24 5. Thickness: 2 - 6 mil
25 6. Material: Polyester
26 7. Removability: Removable with heat/adhesive remover
27 8. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A
28 a. Flame Spread: 25 maximum.
29 b. Smoke Developed: 450 maximum.
30

31 **2.4 GLAZING COMPOUNDS**

- 32 A. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties;
33 non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range
34 of 15 to 25; color as selected.
35

36 **2.5 ACCESSORIES**

- 37 A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each
38 square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method
39 and pane weight and area.
40 B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the
41 height of the glazing stop x thickness to suit application, self adhesive on one face.
42 C. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum
43 water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor
44 retarder seal.
45 D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
46 E. Glazing Clips: Manufacturer's standard type.
47

48 **PART 3 EXECUTION**

49
50 **3.1 VERIFICATION OF CONDITIONS**

- 51 A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at
52 corners.
53 B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement,
54 weeps are clear, and support framing is ready to receive glazing system.
55

- 1 **3.2 PREPARATION**
- 2 A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings
- 3 that are not tightly bonded to substrates.
- 4 B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- 5 C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.
- 6
- 7 **3.3 INSTALLATION, GENERAL**
- 8 A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless
- 9 more stringent requirements are indicated, including those in glazing referenced standards.
- 10 B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- 11 C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- 12 D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- 13
- 14 **3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**
- 15 A. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- 16 B. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- 17 C. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.
- 18
- 19 **3.5 INSTALLATION - VINYL FILM**
- 20 A. Install vinyl film with adhesive, applied in accordance with film manufacturer's instructions.
- 21 B. Place without air bubbles, creases or visible distortion.
- 22 C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at
- 23 perimeter of glazed panel unless otherwise required. Do not score the glass.
- 24 D. Verify pattern prior to material acquisition.
- 25 E. Application must be performed by qualified installer.
- 26
- 27 **3.6 CLEANING**
- 28 A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners
- 29 recommended by manufacturers.
- 30 B. Remove non-permanent labels immediately after glazing installation is complete.
- 31 C. Clean glass and adjacent surfaces after sealants are fully cured.
- 32 D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with
- 33 glass manufacturer's written recommendations.
- 34 E. Protect completed glass finish during remainder of construction period.
- 35

36 **END OF SECTION**

37

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SECTION 08 83 00
MIRRORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass mirrors.

1.2 RELATED REQUIREMENTS

- A. Section 10 2800 - Toilet, Bath, and Laundry Accessories

1.3 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- B. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).
- C. GANA (TIPS) - Mirrors: Handle with Extreme Care (Tips for the Professional on the Care and Handling of Mirrors); 2011.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

1.5 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass; ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503.
 - 1. Size: As noted on drawings.

2.2 ACCESSORIES

- A. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.2 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.3 INSTALLATION

- A. Install mirrors in accordance with GANA (TIPS) and manufacturers recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.4 CLEANING

- A. Remove labels after work is complete.
- B. Clean mirrors and adjacent surfaces.

END OF SECTION

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Custom curved metal frame for curved walls.
- D. Metal channel ceiling framing.
- E. Acoustic insulation.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.
- I. Aluminum reveals, trim, and base.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- C. Section 09 3000 - Tiling: Tile backing board.

1.3 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015, with Editorial Revision (2016).
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2017a.
- I. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2015.
- J. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.
- K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- L. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2013.
- M. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
- N. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- O. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2015.
- P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- Q. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- R. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- S. GA-216 - Application and Finishing of Gypsum Board; 2016.
- T. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association; 2016.
- U. UL (FRD) - Fire Resistance Directory; current edition.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

- 1 C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with
2 requirements.

3
4 **1.5 QUALITY ASSURANCE**

- 5 A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years
6 of experience.

7
8 **PART 2 PRODUCTS**

9
10 **2.1 GYPSUM BOARD ASSEMBLIES**

- 11 A. Provide completed assemblies complying with ASTM C840 and GA-216.
12 B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
13 1. Acoustic Attenuation: STC of 50-54 calculated in accordance with ASTM E413, based on tests conducted in
14 accordance with ASTM E90.
15 C. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
16 1. Fire Rated Partitions: UL listed assembly No. U419; 2 hour rating.
17 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL
18 (FRD).

19
20 **2.2 METAL FRAMING MATERIALS**

- 21 A. Manufacturers - Metal Framing, Connectors, and Accessories:
22 1. Clarkwestern Dietrich Building Systems LLC; www.clarkdietrich.com.
23 2. Jaimes Industries; www.jaimesind.com/#sle.
24 3. Phillips Manufacturing Co; www.phillipsmfg.com/#sle.
25 4. Steel Construction Systems; www.steelconsystems.com/#sle.
26 5. Substitutions: See Section 01 6000 - Product Requirements.
27 B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to
28 comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
29 1. Studs: "C" shaped with flat or formed webs with knurled faces.
30 2. Runners: U shaped, sized to match studs.
31 3. Ceiling Channels: C-shaped.
32 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
33 5. Resilient Furring Channels: 1/2 inch depth, for attachment to substrate through both legs; both legs expanded metal
34 mesh.
35 a. Products:
36 1) Same manufacturer as other framing materials.
37 C. Hand Formable Metal Framing: As specified for Non-structural metal framing studs and tracks.
38 1. Minimum Metal Thickness: 0.033 inch.
39 2. Coating: G60.
40 3. Web Depth: As indicated on drawings to match adjacent wall framing.
41 4. Flange height: 1-1/2 inch.
42 a. Products:
43 1) Basis of Design: Radius Track Corporation; Hand-Formable Ready-Track: www.radiustrack.com
44 D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
45 E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using
46 slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of
47 partition.
48 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable
49 code, when evaluated in accordance with AISI S100-12.
50 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
51 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
52 4. Deflection and Firestop Track:
53 a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the
54 fire-rating of the wall assembly.
55 b. Products:
56 1) FireTrak Corporation; Posi Klip.
57 2) Metal-Lite, Inc; The System.
58 F. Preformed Top Track Firestop Seal:

- 1 1. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
- 2 2. Products:
- 3 a. Hilti, Inc; Top Track Seal CFS TTS: www.us.hilti.com/#sle.
- 4 b. Substitutions: See Section 01 6000 - Product Requirements.
- 5

2.3 BOARD MATERIALS

- 6 A. Manufacturers - Gypsum-Based Board:
 - 7 1. American Gypsum Company; www.americangypsum.com.
 - 8 2. CertainTeed Corporation; www.certainteed.com.
 - 9 3. Continental Building Products; www.continental-bp.com/#sle.
 - 10 4. Georgia-Pacific Gypsum; www.gpgypsum.com.
 - 11 5. National Gypsum Company; www.nationalgypsum.com/#sle.
 - 12 6. USG Corporation; www.usg.com.
 - 13 7. Substitutions: See Section 01 6000 - Product Requirements.
- 14 B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 15 1. Application: Use for Vertical Surfaces above 8'-0" A.F.F., ceilings, soffits, and bulkheads., unless otherwise indicated.
 - 16 2. Unfaced fiber-reinforced gypsum panels as defined in ASTM C1278/C1278M, suitable for paint finish, of the same core type and thickness may be substituted for paper-faced board.
 - 17 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 18 a. Mold-resistant board is required whenever board is being installed before the building is enclosed and
 - 19 conditioned.
 - 20 b. Mold resistant board is required in all restroom locations.
 - 21 4. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is
 - 22 indicated, use Type X board, UL or WH listed.
 - 23 5. Thickness:
 - 24 a. Vertical Surfaces: 5/8 inch.
 - 25 b. Ceilings: 5/8 inch.
- 26 C. Impact Resistant Wallboard:
 - 27 1. Application: All exposed Vertical Surfaces below 8'-0" A.F.F..
 - 28 2. Surface Abrasion: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 29 3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 30 4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 31 5. Hard Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 32 6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 33 7. Type: Fire resistance rated Type X, UL or WH listed.
 - 34 8. Thickness: 5/8 inch.
 - 35 9. Edges: Tapered.
 - 36 10. Products:
 - 37 a. American Gypsum Company; M-Bloc IR Type X.
 - 38 b. Continental Building Products; Protecta HIR 300 Type X with Mold Defense.
 - 39 c. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.
 - 40 d. National Gypsum Company; Gold Bond HI-Impact XP Gypsum Board.
 - 41 e. National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel.
- 42 D. Backing Board For Wet Areas: One of the following products:
 - 43 1. Application: Surfaces behind tile in wet areas including tub and shower surrounds, shower ceilings, and all restroom
 - 44 walls and ceilings.
 - 45 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 46 3. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - 47 a. Standard Type: Thickness 5/8 inch.
 - 48 b. Fire Resistant Type: Type X core, thickness 5/8 inch.
 - 49 c. Products:
 - 50 1) Georgia-Pacific Gypsum; DensShield Tile Backer.
 - 51 2) National Gypsum Company; Gold Bond eXP Tile Backer.
 - 52 3) Substitutions: See Section 01 6000 - Product Requirements.

1 **2.4 ACCESSORIES**

- 2 A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: as required to fill width of wall
3 cavity.
- 4 B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl
5 sealant.
- 6 1. Products:
- 7 a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant:
8 www.titebond.com/#sle.
- 9 b. Liquid Nails, a brand of PPG Architectural Coatings; AS-825 Acoustical Sound Sealant:
10 www.liquidnails.com/#sle.
- 11 c. Substitutions: See Section 01 6000 - Product Requirements.
- 12 C. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
- 13 1. Straight Aluminum Base:
- 14 a. 4" H, 14ga wall base
- 15 b. Clear, brushed, or satin aluminum finish
- 16 c. Surface installed with adhesive, no surface screws or nails
- 17 D. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- 18 1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
- 19 E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood
20 Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- 21 F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel
22 drill screws, corrosion resistant.
- 23 G. Aluminum Gypsum Board Reveals and Moldings.
- 24 1. Basis of Design: Fry Reglet: www.fryreglet.com
- 25 a. Locations: As indicated on drawings and per construction best practices. Coordinate all locations with
26 Architect.
- 27 b. Clear, brushed, or satin aluminum finish
- 28 1) Control Joints: 'Reveal' DRM-625-50
- 29 2) Reveals: 'Z Reveal' DRMZ-625-50
- 30 3) Other profiles as indicated on drawings.
- 31 I. Reveal/Picture Hanger Trim
- 32 1. Basis of Design: AS Hanging Display Systems: www.ashanging.com
- 33 a. Classic Gallery System: Display Reveal Track and Surface Wall Track as indicated on drawings.
- 34 b. Locations: As indicated on drawings and at length indicated.
- 35 c. Clear, brushed, or satin aluminum finish
- 36 d. Provide P-End (Display Reveal Compatible) Stainless Steel Cable/Hooks to hang artwork minimum of 1'-0" O.C.
37 per each length of track. 96" lengths to be provided.
- 38 J. Reveal Aluminum Base: (AB-1)
- 39 1. Basis of Design: Fry Reglet: www.fryreglet.com
- 40 a. '4" Millwork Reveal Base' MWRB50400
- 41 b. Locations: As indicated on drawings
- 42 c. 4" H, 14ga wall base
- 43 d. Clear, brushed, or satin aluminum finish
- 44 K. Straight Aluminum Base: (AB-2)
- 45 1. Locations: As indicated on drawings
- 46 2. 4" H, 14ga wall base
- 47 3. Clear, brushed, or satin aluminum finish
- 48 4. Surface installed with adhesive, no surface screws or nails
- 49 L. Refer to specification Section 10 26 00 for Corner Guards and Wall Protection

50
51 **PART 3 EXECUTION**

52
53 **3.1 EXAMINATION**

- 54 A. Verify that project conditions are appropriate for work of this section to commence.
- 55

56 **3.2 FRAMING INSTALLATION**

- 57 A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- 58 B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.

- 1 1. Level ceiling system to a tolerance of 1/1200.
- 2 C. Studs: Space studs at 16 inches on center.
- 3 1. Extend partition framing to structure in all locations.
- 4 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and
- 5 structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's
- 6 instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- 7 D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at
- 8 jambs.
- 9 E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and
- 10 ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
- 11 F. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- 12 G. Blocking: Install wood blocking for support of:
- 13 1. Framed openings.
- 14 2. Wall mounted cabinets.
- 15 3. Plumbing fixtures.
- 16 4. Toilet accessories.
- 17 5. Wall mounted door hardware.

18 3.3 ACOUSTIC ACCESSORIES INSTALLATION

- 19 A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items
- 20 within partitions, and tight to items passing through partitions.
- 21 B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

22 3.4 BOARD INSTALLATION

- 23 A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly
- 24 visible locations.
- 25 B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm
- 26 bearing.
- 27 C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- 28 D. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance
- 29 with ANSI A108.11 and manufacturer's instructions.
- 30 E. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of non-rated double-layer
- 31 assemblies, which may be installed by means of adhesive lamination.
- 32 F. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

33 3.5 INSTALLATION OF TRIM AND ACCESSORIES

- 34 A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- 35 B. Corner Beads: Install at external corners, using longest practical lengths.
- 36 C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

37 3.6 JOINT TREATMENT

- 38 A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
- 39 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
- 40 2. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
- 41 B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
- 42 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

43 3.7 TOLERANCES

- 44 A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

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END OF SECTION

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SECTION 09 30 00
TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Non-ceramic trim.
- E. Waterproofing membrane.

1.2 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.
- C. Section 22 4000 - Plumbing Fixtures: Shower receptor.

1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- N. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2012 (Revised).
- O. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- P. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.
- Q. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014.
- R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2012.
- S. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2016.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

- C. Samples: Submit two full tiles in each size and color.
- D. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- E. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - Extra Wall Tile: 1 box or 10 pieces of each size, color, and surface finish combination whichever is more.
 - Extra Floor Tile: 1 box or 10 pieces of each size, color, and surface finish combination whichever is more.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 TILE

- A. Manufacturers: All products of each type by the same manufacturer.
 - 1. Dal-Tile Corporation: www.daltile.com.
 - 2. Emil Group, Ergon: www.emilamerica.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Glazed Wall Tile, Type PCT-1: ANSI A137.1, standard grade.
 - 1. Products:
 - a. Refer to Interior Finish Specification on A600 for manufacturer, product, size, and pattern information..
- C. Porcelain Tile, Type PCT-2: ANSI A137.1, standard grade.
 - 1. Products:
 - a. Refer to Interior Finish Specification on A600 for manufacturer, product, size, and pattern information..
- D. Interior Wall Tile: Refer to Interior Finish Specification on A600.
- E. Interior Floor Tile: Refer to Interior Finish Specification on A600.

2.2 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Brushed stainless steel, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.
 - b. Wall corners, outside.
 - c. Transition between floor finishes of different heights.
 - d. Thresholds at door openings.
 - e. Borders and other trim as indicated on drawings.
 - 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.3 SETTING MATERIALS

- A. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - 1. Applications: Use this type of bond coat where indicated and where no other type of bond coat is indicated.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX N 23 MICROTEC: www.ardexamericas.com/#sle.
 - b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com.
 - c. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex: www.merkrete.com/sle.
 - d. TEC, an H.B. Fuller Construction Products Brand; TEC Ultimate Large Tile Mortar: www.tecspecialty.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 - 1. Products:
 - a. ARDEX Engineered Cements; A 38: www.ardexamericas.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: www.laticrete.com/#sle.

- c. Merkrete, by Parex USA, Inc; Merkrete Underlay C: www.merkrete.com/sle.
- d. Proflex Products, Inc; MSI - Mud Set Installation: www.proflex.us.
- e. Substitutions: See Section 01 6000 - Product Requirements.

2.4 GROUTS

- A. Urethane Grout: Water-based, urethane grout (modified ANSI 118.3-UG)
 - 1. Colors: Refer to Interior Finish Specification on A600.
 - 2. Products:
 - a. Basis-of-Design: Bostik, GoldPlus Waterproofing and Antifracture Membrane

2.5 Maintenance Materials

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com.
 - c. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.

2.6 ACCESSORY MATERIALS

- A. Waterproofing Membrane continuous under floor and wall tile: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with [ANSI A118.10](#).
 - 1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
 - 2. Bonded Sheet Membrane Type:
 - a. Material: Polyethylene sheet membrane with non-woven fabric laminated to both sides, 8 mils thick, nominal.
 - 1) Provide waterproofing seaming and accessories membrane by the same manufacturer.
 - b. Products:
 - 1) Schluter; Kerdi: www.schluter.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.3 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

- 1 E. Form internal angles square and external angles square.
- 2 F. Install non-ceramic trim in accordance with manufacturer's instructions.
- 3 G. Sound tile after setting. Replace hollow sounding units.
- 4 H. Keep control and expansion joints free of mortar, grout, and adhesive.
- 5 I. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- 6 J. Grout tile joints unless otherwise indicated.
- 7 K. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer
8 rod as appropriate to prevent three-sided bonding.
- 9

10 **3.4 INSTALLATION - FLOORS - THIN-SET METHODS**

- 11 A. Over interior substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat,
12 with standard grout, unless otherwise indicated.
 - 13 1. Use uncoupling membrane under all tile unless other underlayment is indicated.
 - 14 2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland
15 cement grout.

16
17 **3.5 INSTALLATION - WALL TILE**

- 18 A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet
19 rooms.

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21 **3.6 CLEANING**

- 22 A. Clean tile and grout surfaces.

23
24 **3.7 PROTECTION**

- 25 A. Do not permit traffic over finished floor surface for 4 days after installation.

26
27 **END OF SECTION**

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.
- C. Suspended linear wood acoustic ceiling system.

1.2 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2017.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- E. UL (FRD) - Fire Resistance Directory; current edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit 2 sample 6 by 6 inch in size illustrating material and finish of each acoustical units.
- D. Samples: Submit two samples each, 6 inches long, of suspension system main runner and transitions, and trim..
- E. Samples: Submit one product sample for approval by architect of linear wood ceiling system.
- F. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - a. Extra Acoustical Units: 10 units of each ceiling type specified.
 - b. Wood Linear System: 20 linear feet of each linear size specified.

1.5 QUALITY ASSURANCE

- A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Linear open ceiling system for this project shall maintain the quality as instituted by the architect or A.W.I.
- E. Linear open ceiling system wood shall be kiln dried to 10%. Cracking, checking and warpage of members will not be acceptable.

1.6 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Basis of Design: Armstrong World Industries, Inc; Optima: www.armstrong.com.
 - 2. CertainTeed Corporation; www.certainteed.com.
 - 3. Hunter Douglas Architectural; www.hunterdouglasarchitectural.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

- 1 B. Linear Wood Acoustic Ceiling System:
- 2 1. Basis of Design: Architectural Component Group, Inc; Linear Open Series 2 LO2 Wood Ceiling System
- 3 www.acgiwood.com.
- 4 2. Substitutions: See Section 01 6000 - Product Requirements.
- 5 C. Suspension Systems:
- 6 1. Same as for acoustical units.
- 7

8 2.2 ACOUSTICAL UNITS

- 9 A. Acoustical Units - General: ASTM E1264, Class A.
- 10 1. Refer to reflected ceiling plan and material finish specifications drawing sheet for ceiling types and information.
- 11 2. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of
- 12 suspension system.
- 13 B. Acoustical Tile Type ACT-1: Fiberglass, ASTM E1264 Type III, with the following characteristics:
- 14 1. Size: 24 by 24 inches.
- 15 2. Thickness: 1 inches.
- 16 3. Composition: Fiberglass.
- 17 4. Light Reflectance: 0.9 percent, determined in accordance with ASTM E1264.
- 18 5. NRC Range: 0.9 to 1.0, determined in accordance with ASTM E1264.
- 19 6. Edge: Square Tegular.
- 20 7. Surface Color: White.
- 21 8. Surface Texture: Fine.
- 22 9. Recycle Content: Consumer 12% minimum, Pre-Consumer 59% minimum
- 23 10. Binder: Plant Based
- 24 11. Products:
- 25 a. Refer to Interior Finish Specification on A600..
- 26 C. Acoustical Tile Type ACT-2: Fiberglass, ASTM E1264 Type III, with the following characteristics:
- 27 1. Size 48 by 48 inches.
- 28 2. Thickness: 1 inch.
- 29 3. Composition: Fiberglass.
- 30 4. Light Reflectance: 0.9 percent, determined in accordance with ASTM E1264.
- 31 5. NRC Range: 0.9 to 1.0, determined in accordance with ASTM E1264.
- 32 6. Edge: Square Tegular
- 33 7. Surface Color: White
- 34 8. Surface Texture: Fine
- 35 9. Recycled Content: Consumer 12%minimum, Pre-Consumer 59% minimum.
- 36 10. Binder: Plant Based
- 37 11. Products:
- 38 a. Refer to Interior Finish Specification on A600.
- 39

40 2.3 SUSPENSION SYSTEM(S)

- 41 A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer
- 42 bars, clips, splices, perimeter moldings, and hold down clips as required.
- 43 B. Exposed Steel Suspension System: Galvanized Formed steel, commercial quality cold rolled; heavy-duty.
- 44 1. Profile: Tee; 9/16 inch wide face.
- 45 2. Finish: White painted.
- 46 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product by one of the following:
- 47 a. Armstrong World Industries, Inc..
- 48 b. Chicago Metallic Corporation..
- 49 c. USG Interiors, Inc.
- 50

51 2.4 ACCESSORIES

- 52 A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling
- 53 system flatness requirement specified.
- 54 B. Touch-up Paint: Type and color to match acoustical and grid units.
- 55

56 2.5 LINEAR WOOD ACOUSTIC CEILING SYSTEM

- 57 A. Linear Open Series 2 wood system, Type LWC-1; with the following characteristics:
- 58 1. Wood Planks shall be provided in a size of 3-1/4", 5-1/4", and 7-1/4" wide x 3/4" thick.

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2. Wood plank shall be random lengths up to 10' for solid wood.
 3. Wood planks shall be installed with a 3/4" reveal between planks. Linear wood members shall be 4", 6", and 8" module size (with the module size equal to wood plank width plus 3/4" reveal; 3-1/4" wide plank plus 3/4" reveal equals 4" module).
 4. Black non-woven felt shall be factory attached to one long edge of each plank.
 5. Wood Species: Type-WD-1, Refer to Interior Finish Specification on A600. System shall consist of Urban Ash Wood sourced directly through a certified Wisconsin Urban Wood Supplier. <http://wisconsinurbanwood.org/sawyers/>
 - a. Raw lumber to be milled to manufactures specification and shipped to manufacturing facility for final milling and finishing.
 - b. Sourced Urban Ash shall be from the Pinney Library Neighborhood and greater Madison area to greatest extent possible.
 - c. Coordinate sourcing, sawing, drying, and milling between Wisconsin Urban Wood Supplier and Linear Wood Acoustic Ceiling system manufacturer.
 6. Finish: Wood finish shall utilize custom stain to match architects sample with satin sheen. Back of planks shall be factory sealed.
 7. Fire Rating: Panels shall achieve a Class A Fire Rating.
 8. Normal Installation is with a factory-attached, black, non-woven felt reveal between planks.
 9. Attachment System: Linear Wood Ceiling System shall be suspended according to manufacturer's suggested method of suspension to accommodate the wood size, spacing, and weight.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.

3.3 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 1. Make field cut edges of same profile as factory edges.
 2. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

3.4 INSTALLATION - LINEAR WOOD ACOUSTIC CEILING SYSTEM

- A. Linear Wood Ceiling System shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by manufacturer.
- B. The contractor shall suspend planks in accordance with manufacturer's recommended installation guides and shop drawings.

- 1 C. The ceiling system shall be suspended by 15/16" black HD T-grid with main runners on 2' centers and cross T's every 4'.
2 D. Planks shall be installed by screwing LSC-101 and LSC-105 clips into the T-Grid and attaching the wood members in
3 accordance to the manufactures' installation instructions. LSC-106 alignment clips shall be used at plank end-joints.
4 E. Contractor shall clean all panels prior to installation according to manufacturer's recommended maintenance procedures.
5 Upon completion of installation, panels shall be inspected and cleaned as needed.
6

7 **3.5 TOLERANCES**

- 8 A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
9 B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.
10
11

END OF SECTION

**SECTION 09 6229
CORK FLOORING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Natural cork tile flooring.
- B. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 6900 – Access Flooring

1.3 REFERENCE STANDARDS

- A. ASTM F386 - Standard Test Method for Thickness of Resilient Flooring Materials Having Flat Surfaces; 2017.
- B. ASTM F2055 - Standard Test Method for Size and Squareness of Resilient Floor Tile by Dial Gage Method; 2017.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cork Floor Tiles:
 - 1. Capri: www.capricollections.com

2.2 Components

- A. Cork Floor Tiles: Cork granules bonded into sheets; cork throughout full thickness, free of hardback cork and foreign material; smooth top and bottom surfaces; bottom surface suitable for adhesive bonding; free of cracks, broken corners and edges, indentations, and anomalous color variations.
 - 1. Thickness: 5/16 inch, minimum.
 - 2. Dimensional Tolerances:
 - a. Squareness: Not more than 0.005 inch out of square when tested in accordance with ASTM F2055.
 - b. Thickness: Maximum of plus / minus 0.005 inch deviation from specified thickness except for beveled edges, when tested in accordance with ASTM F386.
 - c. Length and Width: Maximum of plus or minus 0.016 inch deviation from specified dimensions, when tested in accordance with ASTM F2055.
 - 3. Edges: Square.
 - 4. Refer to Interior Finish Specifications on A600 for Raised Access Floor Finish RAFF-1.

2.3 ACCESSORIES

- A. Adhesive and Primer: Waterproof; types recommended by flooring and raised access flooring manufacturer.

3.2 FLOORING INSTALLATION

- A. Factory installed directly to Raised Access Floor Panel. Refer to Section 09 6900 – Access Flooring.

END OF SECTION

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**SECTION 09 65 00
RESILIENT FLOORING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Resilient base.
- C. Rubber mat tile flooring.
- D. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 6900 - Access Flooring.

1.3 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Verification Samples: Submit two 6" long wall base samples illustrating color for each resilient material specified.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 20 square feet of each type and color.
 - 3. Extra Wall Base: 20 linear feet of each type and color.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.

1.6 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 SHEET FLOORING

- A. PVC-Free Resilient Sheet Flooring: Mineral and thermoplastic polymer construction; ionomer-impregnated wear surface.
 - 1. Manufacturers:
 - a. Mannington: www.manningtoncommercial.com
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. VOC Content Limits: As specified in Section 01 6116.
 - 3. Thickness: 0.080 inch nominal.
 - 4. Seams: Heat welded.
 - 5. Color and Product: Refer to Interior Finish Specification on A600..
- B. Rubber Mat Tile Flooring:
 - 1. Manufacturers:
 - a. Fuji Mats: www.fujifloor.com
 - b. Substitutions: See Section 01 6000 - Product Requirements.

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2. Color, Product, and Pattern: Refer to Interior Finish Specification on A600.
 3. Non-slip Textured surface.
 4. Waterproof Backing.
 5. Non-adhesive installation.
 - C. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.

2.2 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 1. Manufacturers:
 - a. Basis of Design: Johnsonite, a Tarkett Company; Baseworks Thermoset Rubber Wall Base: www.johnsonite.com.
 - b. Burke Flooring: www.burkeflooring.com/#sle.
 - c. Roppe Corp: www.roppe.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 2. Height: 4 inch.
 3. Profile: Refer to Interior Finish Specification on A600.
 4. Thickness: 0.125 inch.
 5. Finish: Satin.
 6. Length: Roll. No seams acceptable within length of wall.
 7. Color: Refer to Interior Finish Specification on A600.

2.3 ACCESSORIES

- A. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
 1. VOC Content Limits: As specified in Section 01 6116.
- B. Moldings, Transition and Edge Strips: Same material as flooring.
- C. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

3.3 Installation - General

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 Installation - Sheet Flooring

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seal seams by heat welding where indicated.

3.5 Installation - Resilient Base

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.

- 1 C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- 2 D. Scribe and fit to door frames and other interruptions.
- 3

4 **3.6 CLEANING**

- 5 A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- 6 B. Clean in accordance with manufacturer's written instructions.
- 7

8 **3.7 PROTECTION**

- 9 A. Prohibit traffic on resilient flooring for 48 hours after installation.
- 10

11 **END OF SECTION**

12

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SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile and accessories

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 7419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap.
- C. Section 09 6900 - Access Flooring.

1.3 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.
- B. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- C. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- E. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: 2 full boxes or 20 full carpet tiles of each color and pattern installed.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Refer to Interior Finish Specification on A600 for manufacturer, color, and installation requirements.
 - 2. Basis of Design: Interface, Inc; www.interfaceinc.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MATERIALS

- A. Tile Carpeting:
 - 1. VOC Content: Comply with Section 01 6116.
 - 2. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 - 3. Primary Backing Material: GlasBac Tile.

2.3 ACCESSORIES

- A. TacTiles: No glue installation

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

- 1 B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are
- 2 ready to receive carpet tile.
- 3 C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-
- 4 floor surfaces.
- 5 D. Verify that required floor-mounted utilities are in correct location.
- 6

7 **3.2 PREPARATION**

- 8 A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- 9 B. Vacuum clean substrate.
- 10

11 **3.3 INSTALLATION**

- 12 A. Starting installation constitutes acceptance of sub-floor conditions.
- 13 B. Install carpet tile in accordance with manufacturer's instructions.
- 14 C. Blend carpet from different cartons to ensure minimal variation in color match.
- 15 D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- 16 E. Lay carpet tile in pattern and direction as indicated on drawings.
- 17 F. Locate change of color or pattern between rooms under door centerline.
- 18 G. Trim carpet tile neatly at walls and around interruptions.
- 19 H. Complete installation of edge strips, concealing exposed edges.
- 20

21 **3.4 CLEANING**

- 22 A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- 23 B. Clean and vacuum carpet surfaces.
- 24

25 **END OF SECTION**

26

SECTION 09 69 00
ACCESS FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural floor supported pedestal framing system.
- B. Removable floor panels.
- C. Accessories, including fascia panels, plenum dividers, grilles, transitions, support brackets.
- D. System electrostatic grounding.

1.2 RELATED REQUIREMENTS

- A. Section 09 6813 - Tile Carpeting: Finish for access flooring panels.
- B. Section 26 2726 - Wiring Devices: Access Floor Boxes.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Review connection with mechanical and electrical systems.
 - 2. Review procedures for keeping underfloor space clean.

1.5 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data for grid system, panels, and accessories; electrical resistance characteristics and ground connection requirements.
- C. Shop Drawings: Indicate floor layout, interruptions to grid, special sized panels, panels requiring drilling or cut-out for services, appurtenances or interruptions, edge details, elevation differences, toilet carrier support, electrical floor boxes, ramps, grilles, and registers.
- D. Samples: Submit one complete full size floor panel, pedestal, and understructure unit for each type of access flooring system required.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.
- F. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Floor Panels: 10 of each unfinished panel size. 2 of each factory applied finish panel size.
 - 3. Extra Pedestals and Stringers: 20 each.
 - 4. Provide 2 panel lifting devices.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design floor system structure layout for this project under direct supervision of a Professional Structural Engineer experienced in design of floors of the type required and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the type of work required in this section, with minimum 5 years of experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Access Flooring:
 - 1. Basis of Design: Tate Access Floors, Inc; ConCore 1500: www.tateaccessfloors.com.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

57 **2.2 ACCESS FLOORING**

- 58 A. Access Flooring: Factory-fabricated system consisting of removable floor panels and supporting structure that allows
59 access to each space below floor without requiring removal of panels other than the one directly above the space to which
60 access is needed; provide all components and accessories required for complete installation and as indicated.
- 61 1. Configuration: Stringerless system.
 - 62 2. Finished Floor Elevation: Top of access floor 18 inches nominal height above building structural floor.
 - 63 3. Floor Panel Size: 24 by 24 inches.
- 64 B. Performance Requirements:
- 65 1. Structural Performance: Provide access flooring capable of complying with the following performance requirements
66 according to testing procedures in CISCA's "Recommended Test procedures for Access Floors":
 - 67 a. Concentrated Loads: 1000 lbs with the following deflection and permanent set:
 - 68 1) Top-surface Deflection: 0.10 inch
 - 69 2) Permanent Set: 0.010 inch
 - 70 b. Ultimate Loads: 3000 lbs
 - 71 c. Rolling Loads: with local or overall deformation not to exceed 0.040 inch.
 - 72 1) Rolling 10-Pass at 1250 lbf
 - 73 2) 10,000-Passes at 1000 lbf
 - 74 d. Stringer Load Test: 450 lbf at center of span with a permanent set not to exceed 0.010 inch
 - 75 e. Pedestal Axial Load Test: 5000 lbf without permanent deformation
 - 76 f. Pedestal-Overturning-Moment Test: 1000 inch-pound
 - 77 g. Uniform Load Test: 500 lbf/sq. ft. with a maximum top-surface deflection not to exceed 0.040 inch and a
78 permanent set not to exceed 0.010 inch.
 - 79 h. Drop Impact Load Test: 150 lb.
 - 80 i. Fire Performance:
 - 81 1) Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify
82 products with appropriate markings of applicable testing agency.
 - 83 (a) Flame-Spread index: 25 or less.
 - 84 (b) Smoke-Developed Index: 50 or less.
 - 85 j. Recycled Content of Steel Products: See Section 01 8113 - Sustainable Design Requirements for recycled
86 content requirements.
 - 87 2. Pedestals:
 - 88 a. Pedestal assemblies shall be corrosive resistant, all steel or aluminum or a combination welded construction,
89 and provide an adjustment range of +/- 1" for finished floor heights 6" or greater.
 - 90 b. Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height, which
91 requires deliberate action to change height setting and prevents vibration displacement.
 - 92 c. Pedestal assembly shall be of required height to bring finished floor to elevations indicated.
 - 93 3. Floor Panels: Conform to the following:
 - 94 a. Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight
95 cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are
96 unacceptable.
 - 97 b. Size: Nominal 24 by 24 inches.
 - 98 c. Attachment to understructure: Bolted.
 - 99 d. Floor Panel Covering: Field Applied typical, RAFF-1 and RAFF-2 to be Factory Applied. Refer to Interior Finish
100 Specification on A600.

101
102 **2.3 OWNER SUPPLIED MATERIALS**

- 103 A. Surplus raised access flooring stock from the Central Madison Public Library renovation project has been stored for use at
104 Pinney Library. The following components shall be considered for use at the Pinney in the construction of the raised access
105 floor system. The contractor will be responsible for picking up, loading, and transporting materials from the Library Support
106 Center located at 1301 W. Badger Road, Madison, Wisconsin (where the materials are stored) to the construction site.
107 Contact Brian Jensen for coordination of pickup at bjensen@madisonpubliclibrary.org or (608) 266-6355.
- 108 1. ConCore 1500, 24in x 24in Floor Panels – Qty: 233
 - 109 2. Pedestal Top Adjuster Plates – Qty: 480

110
111 **2.4 COMPONENTS**

- 112 A. Pedestals: Steel with flat bottom base plate, threaded supporting rod, vibration proof lock nut to permit 1-1/2 inch
113 adjustment, galvanized finish.
- 114 B. Frame Grid Stringers: Continuous type, consisting of steel channels, box, or tee sections.

- 115 C. Floor Panels:
116 1. Sheet steel plates, composite lightweight concrete core.
117 2. Floor Panel Finish Adhesive: Moisture resistant type recommended by floor finish manufacturer.
118 D. Acrylic Window Panel
119 1. Provide 8 (24"x24") acrylic window panels to be field located per approved location of architect/owner. Provide all
120 required supports, fasteners, and accessories for seamless installation of panel in specified raised access floor
121 system.
122 a. 1-1/4" thick acrylic with chamfered edges.
123 b. 24" x 24" square.
124 c. Load Capacity: 1000 lbs; Rolling Load Capacity: 800 lbs for 10 passes and 600 lbs for 10,000 passes.
125 d. Drilled and countersunk for cornerlocking in PosiLock understructure
126

127 2.5 ACCESSORIES

- 128 A. Electrostatic Grounding Connectors: Solid copper.
129 B. Gaskets: Closed cell sponge rubber, preformed to suit.
130 C. Sealant: Any water-based, moisture-curing, or chemically-curing joint sealant suitable for purpose and compatible with
131 materials being sealed; except acrylic latex emulsion.
132 D. Adhesives: manufacturer's standard adhesive for bonding pedestal bases to subfloor.
133 E. Service Outlets: Standard UL-listed and labeled assemblies, for recessed mounting flush with top of floor panels; for power,
134 communication, and signal services; and complying with the following requirements:
135 1. Structural Performance: cover capable of supporting a 1000-lbf concentrated load.
136 2. Cover and Box Type: Grommet with twist-close cover and including steel junction box for electrical receptacle with
137 provision for telephone connectors and signal cables.
138 3. Location: In center of panel quadrant unless otherwise indicated.
139 4. Receptacles and Wiring: Electrical receptacles and wiring for service outlets are specified elsewhere.
140 F. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required.
141 G. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and forming
142 transition between access flooring and adjoining floor coverings at same level as access flooring.
143 H. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the
144 contract drawings.
145 I. Additional support and trim: Provide additional support, trim, and anchoring as required at toilet carrier mounting
146 locations and all recessed door closer, lock, and socket locations.
147

148 2.6 FINISHES

- 149 A. Finish the surface of floor panels with floor covering material as indicated on the contract drawings. All areas to be
150 furnished with laminated floor panels must be maintained at ambient temperature between 50° to 90° F and at humidity
151 level between 20% to 80% relative and shall remain within these ranges through installation and occupancy.
152 1. RAFF-1 and RAFF-2 to be factory installed. Refer to Interior Finishes Specification on A600 for list of flooring
153 materials.
154 2. Refer to Interior Finishes Specification on A600 for list of flooring materials to be field installed.
155

156 2.7 SOURCE QUALITY CONTROL

- 157 A. Fabrication Tolerances:
158 1. Floor Panel Flatness: Plus or minus 0.02 inch in any direction.
159 2. Floor Panel Width or Length From Specified Size: Plus or minus 0.02 inch.
160 3. Floor Panel Squareness: Plus or minus 0.03 inch difference between opposite diagonal dimensions.
161

162 PART 3 EXECUTION

163 3.1 EXAMINATION

- 164 A. Verify field measurements are as shown on shop drawings.
165 B. Verify that required utilities are available, in proper location, and ready for use.
166
167

168 3.2 PREPARATION

- 169 A. Vacuum clean substrate surfaces.
170

171 3.3 INSTALLATION

- 172 A. Install components in accordance with manufacturer's instructions.

- 173 B. Refer to Raised Access Floor Plan Level 1 on A101.1 for panel layout and under floor coordination.
- 174 B. Secure pedestal base plate to subfloor with adhesive.
- 175 C. Install additional pedestals where grid pattern is interrupted by room appurtenances or at cut-outs.
- 176 D. Install stringers and floor panels on pedestals with full bearing.
- 177 E. Close field cut floor panels with edge trim.
- 178 F. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and cutouts.
- 179 G. Cut and install floor panels as tight as possible to existing columns, pipes, and floor penetrations and close with edge trim.
- 180 H. Install factory applied finishes to panels in accordance with manufacturer's specification. Refer to Interior Finish
- 181 Specification on A600 for factory installed finishes.
- 182

183 **3.4 TOLERANCES**

- 184 A. Maximum Out of Level Floor Panel Tolerance: 1/16 inch in 10 ft, non-cumulative.

185 **3.5 ADJUSTING**

- 186 A. Adjust pedestals to achieve a level floor and to assure adjacent floor panel surfaces are flush.
- 187

188 **END OF SECTION**

189

**SECTION 09 72 00
WALL COVERINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall covering.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; 2002 (Reapproved 2013).
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- C. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2015.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Samples: Submit two samples of wall covering, 24" by 48" in size illustrating color, finish, and texture.
- D. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
- E. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering; store where directed.
 - 3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.7 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Refer to Interior Finish Specification on A600 for color, style, and finish.
 - 1. Basis of Design - Wall Coverings:
 - a. VWC-1 and VWC02: DL Couch
 - b. VWC-3: Carnegie
 - c. VWC-4: Wolf Gordon

2.2 MATERIALS

- A. Requirements for Wall Coverings:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

- 1 2. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in
2 accordance with ASTM D1308.
- 3 3. Wall Covering: Color, size, pattern, and locations as indicated on the drawings.
- 4 B. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- 5

6 **PART 3 EXECUTION**

7
8 **3.1 EXAMINATION**

- 9 A. Verify that substrate surfaces are prime painted and ready to receive work, and conform to requirements of the wall
10 covering manufacturer.

11
12 **3.2 PREPARATION**

- 13 A. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- 14 B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to
15 preparing surfaces or finishing.

16
17 **3.3 INSTALLATION**

- 18 A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

19
20 **3.4 CLEANING**

- 21 A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- 22 B. Reinstall wall plates and accessories removed prior to work of this section.

23
24 **3.5 PROTECTION**

- 25 A. Do not permit construction activities at or near finished wall covering areas.

26 **END OF SECTION**

27

28

SECTION 09 84 00
ACOUSTIC WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Acoustic stretched-fabric wall system.
- B. Accessories as required for complete installation.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 7200 - Wall Coverings: Fabric wall coverings for adhesive application to solid wall surfaces.

1.3 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- C. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.
- D. ASTM E2573 - Standard Practice for Specimen Preparation and Mounting of Site-Fabricated Stretch Systems to Assess Surface Burning Characteristics; 2017.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Specimen warranty.
- C. Shop Drawings: Details indicating typical transitions to other finish surfaces.
- D. Verification Samples:
 - 1. For each fabric specified, minimum size 12 inch square, representing actual product in color, texture, and pattern.
 - 2. Acoustic material, minimum size 12 inch square.
- E. Test Reports: Certified test data from an independent test agency verifying that wall and ceiling systems meet specified requirements for acoustical and fire performance.
- F. Warranty Documentation: Submit manufacturer's warranty and ensure that forms have been completed in City of Madison's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Supply an additional 10 (ten) percent of accessories installed for City of Madison's use in maintenance of project.
 - 3. Supply an additional 5 (five) percent of fabric installed for City of Madison's use in maintenance of project.
- F. Submit LEED credit calculations and required paperwork and certification items for review by LEED committee. Version of LEED project required.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect fabric, acoustical backing, and track from excessive moisture in shipment, storage, and handling.
- B. Do not deliver materials to project until wet work such as concrete and plaster has been completed.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1 **1.7 FIELD CONDITIONS**

- 2 A. Do not begin installation until interior conditions have reached temperature and humidity that will be maintained during
3 occupancy.
4 B. Do not install products under environmental conditions outside manufacturer's absolute limits.
5

6 **1.8 WARRANTY**

- 7 A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
8 B. Correct defective work within five year period after Date of Substantial Completion.
9

10 **PART 2 PRODUCTS**

11
12 **2.1 MANUFACTURERS**

- 13 A. Acoustic Stretched-Fabric Wall and Ceiling System: AWP-1
14 1. Basis of Design: Novawall Systems, Inc; EcoTrack: www.novawall.com/#sle.
15 a. Substitutions: See Section 01 6000 - Product Requirements.
16

17 **2.2 ACOUSTIC STRETCHED-FABRIC SYSTEM**

- 18 A. Acoustic Stretched-Fabric System: Field installed, fabric is stretched and set into framework and laid over acoustic material
19 anchored to substrate. Framework consists of continuous perimeter and intermediate mounting frames anchored to
20 substrate, and designed to permit removal and replacement of fabric within framed areas without affecting adjacent areas.
21 1. Surface Burning Characteristics: Flame Spread Index of 25, maximum; Smoke Developed Index of 450, maximum;
22 when whole system is tested in accordance with ASTM E84 using mounting specified in ASTM E2573 for stretched
23 systems.
24 2. Noise Reduction Coefficient (NRC): 0.80, minimum, when tested in accordance with ASTM C423, Type A mounting
25 per ASTM E795.
26

27 **2.3 MATERIALS**

- 28 A. Frame: Extruded polymer framing system with serrated jaws of sufficient strength to hold fabric in place after repeated
29 applications.
30 B. Acoustic Core Material: (All locations above 8'-0" A.F.F.)
31 1. Provide type of acoustic material required to achieve Noise Reduction Coefficient (NRC) indicated.
32 a. Thickness: 2", NRC 1.05
33 2. Ensure that thickness of acoustic material fills depth of frame as necessary for application without use of support
34 blocking.
35 C. Tackable/High Impact: (All locations below 8'-0" A.F.F.)
36 1. Micore by US Gypsum ¾" thick
37 2. Multi-density Fiberglass 1" Multi-density fiberglass, 6 PCF density with ¼" 10-20 PCF face
38 D. Fabric Selection:
39 1. Refer to Interior Finish Specification on sheet A600.
40 E. Mounting Hardware:
41 1. Manufacturer's standard fasteners for securing framing track directly to gypsum board, wood or plywood substrates.
42 Pin nailing through fabric is not accepted.
43 F. Adhesives: Low VOC or water-based, and approved by acoustic stretched-fabric system manufacturer.
44

45 **PART 3 EXECUTION**

46
47 **3.1 EXAMINATION**

- 48 A. Begin installation only after substrates have been properly prepared.
49 B. Verify that casework, markerboards, door and window jambs, finished ceiling, and other finished items adjacent or
50 abutting the acoustic stretched-fabric system have been properly installed.
51 C. When preparation of substrate is the responsibility of another installer, notify Architect of unsatisfactory preparation prior
52 to proceeding with this work.
53

54 **3.2 PREPARATION**

- 55 A. Clean surfaces thoroughly prior to installation of this work.
56 B. Prepare substrate surfaces using methods as recommended by the manufacturer for achieving acceptable result as
57 required for this work.

- 1 C. Remove wall plates and other obstacles, and properly prepare substrates to receive frames and acoustic material in
2 accordance with manufacturer's instructions.
3

4 **3.3 INSTALLATION**

- 5 A. Install acoustic stretched-fabric system at locations indicated in accordance with approved shop drawings and
6 manufacturer's instructions.
7 B. Frames: Install perimeter and intermediate frames using appropriate fasteners for prepared substrate, firmly secured to
8 ensure frames do not separate from substrate.
9 1. For tile or masonry substrates, apply continuous bead of adhesive along base of framing in addition to spacing of
10 conical anchors and/or fasteners at 6 to 8 inches on center.
11 2. Follow contours of wall and scribe to adjoining work at borders, penetrations, and imperfections.
12 3. Install framing around openings and penetrations.
13 4. Allow for spacing of framework to accommodate insertion of installation tool.
14

15 **3.4 CLEANING**

- 16 A. Clean exposed surfaces of acoustic stretched-fabric system in compliance with manufacturers instructions for cleaning and
17 repair of minor damage to exposed surfaces.
18

19 **3.5 MAINTENANCE**

- 20 A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
21 B. Provide a separate maintenance contract for specified maintenance service.
22

23 **END OF SECTION**
24

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**SECTION 09 84 20
DECORATIVE FELT SYSTEMS**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Felt Strip Feature Wall.

1.2 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Submit manufacturer's product data; include product description, fabrication information, and compliance with specified performance requirements.
- C. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.
 - 1. Test reports required are:
 - a. Flame Spread and Smoke Developed (ASTM E 84)
- D. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.
- E. Samples for Verification:
 - 1. Submit minimum 4-inch by 4-inch samples. Indicate pattern and color.
- F. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver profile tiles in manufacturer's standard protective packaging.
- B. Do not deliver profile tiles, components and accessories to Project site until areas are ready for installation.
- C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.
- D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install profile tiles until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Materials must be acclimated in an environment of 65-75 degrees Fahrenheit with maintained relative humidity levels of 25-55% for at least 48 hours prior to beginning the installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Where specific products are listed, other products may be acceptable, subject to compliance with requirements (refer to EDA Contracting Provisions for Construction Projects Article 10), per Prebid substitution request per Section 012500 Substitutions.

2.2 PRODUCT

- A. Product:
 - 1. Basis-of-Design: FilzFelt, CNC Cut Wool Design Felt.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.3 MATERIALS

- a. DFP-1: Felt Strip Feature Wall:
 - 1. Felt strips of length and width indicated on drawings, with powder coated grommets at top and bottom of strips.
 - 2. Supports: Provide steel pipe supports at top and bottom of strips as detailed on drawings. Provide fittings and flanges as necessary. Powder coat all support pieces to match color of felt strip grommets.
 - 3. Felt Style, Thickness, and Color: Refer to Interior Finish Specification on A600.

1 **PART 3 EXECUTION**

2

3 **3.1 EXAMINATION**

4 A. Examine substrates, areas, and conditions where installation of decorative felt systems will occur, with Installer present, for
5 compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and
6 comply with requirements specified.

7

8 **3.2 INSTALLATION**

9 A. General: Comply with manufacturer's written instructions and approved shop drawings.

10 B. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and
11 product data.

12

13 **3.3 CLEANING AND PROTECTION**

14 A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot
15 be repaired to Architect's satisfaction.

16

17 **END OF SECTION**

18

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints, stains, and varnishes.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

- A. Section 01 3329 - Sustainable Design Reporting.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- D. SSPC-SP 1 - Solvent Cleaning; 2015.
- E. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- F. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 2 A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
3 B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface
4 preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
5 C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated
6 area, and as required by manufacturer's instructions.
7

8 **1.7 FIELD CONDITIONS**

- 9 A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint
10 product manufacturer.
11 B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in
12 substrates, and humidity and temperature limitations.
13 C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
14

15 **PART 2 PRODUCTS**

16
17 **2.1 MANUFACTURERS**

- 18 A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
19

20 **2.2 PAINTS AND FINISHES - GENERAL**

- 21 A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
22 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a
23 homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or
24 sags.
25 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
26 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in
27 manufacturer's product instructions.
28 B. Volatile Organic Compound (VOC) Content:
29 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
30 a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
31 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24),
32 exclusive of colorants added to a tint base and water added at project site; or other method acceptable to
33 authorities having jurisdiction.
34 C. Sheens: Provide the sheens specified on drawings. Refer to Interior Finish Specification on A600; where sheen is not
35 specified, sheen will be selected later by Architect from the manufacturer's full line.
36 D. Colors: As indicated on drawings. Refer to Interior Finish Specification on A600.
37

38 **2.3 PAINT SYSTEMS - INTERIOR**

- 39 A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete
40 masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
41 1. Two top coats and one coat primer.
42 2. Top coats for Walls: High Performance durability and scuff-resistant Interior Eggshell Latex.
43 a. PPG: www.ppgpaints.com
44 b. Glidden: <http://www.gliddenprofessional.com>
45 c. Sherwin Williams: www.sherwin-williams.com
46 b. Substitutions : Section 01 6000 - Product Requirements
47 B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and
48 wood:
49 1. Two top coats and one coat primer.
50 2. Top Coat(s): Interior Epoxy-Modified Latex; MPI #115 or 215.
51 a. Products:
52 1) PPG Paints Pitt-Glaze WB Water-Borne Acrylic Epoxy, 16-598 Series, Semi-Gloss.
53 2) Sherwin-Williams Waterbased Catalyzed Epoxy, Semi-Gloss.
54

55 **2.4 PRIMERS**

- 56 A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
57 1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
58 a. Products:

- 1) PPG Paints Pure Performance Interior Latex Primer, 9-900.
- 2) PPG Paints Speedhide zero Interior Latex Sealer, 6-4900XI. (MPI #149)
- 3) Pratt & Lambert Pro-Hide Gold Interior Latex Zero VOC Primer. (MPI #149)
- 4) Rodda Roseal II, 502701. (MPI #149)
- 5) Valspar Professional Interior Latex Primer, No. 11286. (MPI #149)

2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete, and Concrete Masonry Units : 12 percent.
 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- F. Plaster: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.
- G. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- H. Galvanized Surfaces:
- I. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Sand wood and metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

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3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. High performance coatings.
- B. Surface preparation.

1.2 RELATED REQUIREMENTS

- A. Section 01 3515 - LEED Certification Procedures.
- b. Section 09 9123 - Interior Painting: Requirements for mechanical and electrical equipment surfaces.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition, www.paintinfo.com.
- D. SSPC V1 (PM1) - Good Painting Practice: Painting Manual, Volume 1; Fourth Edition.
- E. SSPC-SP 1 - Solvent Cleaning; 2015.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
- C. Samples: Submit two samples 8 by 8 inch in size illustrating colors specified for selection.
- D. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.5 FIELD CONDITIONS

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- D. Restrict traffic from area where coating is being applied or is curing.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."
- B. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:

2.2 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
- B. Epoxy Coating for as indicated on drawings:
 - 1. Number of coats: Two.
 - 2. Top Coat(s): Polyamide Epoxy; MPI #77.
 - a. Sheen: Semi-Gloss.
 - b. Products:

- 58 1) PPG Paints; Amerlock 2VOC: www.ppgpaints.com/sle.
- 59 2) Sherwin-Williams; Macropoxy 646 Fast Cure Epoxy; MPI #177: www.protective.sherwin-williams.com.
- 60 3) Tnemec Company, Inc. Series 287 Enviro-Pox: www.tnemec.com/#sle.
- 61 4) Substitutions: Section 01 6000 - Product Requirements.
- 62 c. Color: Refer to Interior Finish Specifications on A600.
- 63

PART 3 EXECUTION

3.1 EXAMINATION

- 67 A. Verify existing conditions before starting work.
- 68 B. Do not begin application of coatings until substrates have been properly prepared.
- 69 C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow
- 70 manufacturer's instructions for examination and testing of substrates.
- 71 D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially
- 72 affect proper application.
- 73

3.2 PREPARATION

- 74 A. Clean surfaces of loose foreign matter.
- 75 B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- 76 C. Remove finish hardware, fixture covers, and accessories and store.
- 77 D. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- 78 E. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide
- 79 adequate protection. Repair damage.
- 80
- 81

3.3 PRIMING

- 82 A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating
- 83 manufacturer's instructions.
- 84
- 85

3.4 COATING APPLICATION

- 86 A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in
- 87 "MPI Architectural Painting and Specification Manual".
- 88 B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish
- 89 edges, crevices, corners, and other changes in dimension with full coating thickness.
- 90
- 91

3.5 CLEANING

- 92 A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.
- 93 B. Clean surfaces immediately of overspray, splatter, and excess material.
- 94 C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.
- 95
- 96

3.6 PROTECTION

- 97 A. Protect finished work from damage.
- 98
- 99

100 **END OF SECTION**

101

SECTION 10 11 01
VISUAL DISPLAY BOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass Markerboards

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Blocking and supports.
- B. Section 09 2116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.
- C. Section 10 2239 - Folding Panel Partitions: Installation of visual display boards on operable partitions.

1.3 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Samples: Submit two samples 4 by 4 inch minimum in size illustrating materials and finish, color and texture of markerboard and trim.
- C. Maintenance Data: Include data on regular cleaning, stain removal.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage and Handling Requirements:
 - 1. Store and handle materials in accordance with manufacturer's instructions.
 - 2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
 - 3. Store materials in clean, dry area indoors.
 - 4. Protect materials during storage, handling, and installation to prevent damage.

PART 2 PRODUCTS

22 MANUFACTURER

- A. Products:
 - 1. Basis of Design: Clarus Glassboards LLC, www.clarusglassboards.com
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 VISUAL DISPLAY BOARDS

- A. Glass Markerboards: Type - GB-1 and GB-2, Fixed, Glass, Magnetic Dry-Erase Glassboards.
 - 1. Material: 1/4" tempered safety writing glass
 - 2. Features:
 - a. Non-staining writing surface
 - b. Clear polish finish w/ eased corners
 - c. Backpaint finish
 - 3. Backing: Magnetic.
 - 4. Size: Custom sizes as indicated on drawings.
 - 5. Product and Color: Refer to Interior Finish Specification on Sheet A600.
 - 6. Trim and Accessories: Provide aluminum base, channel, and panel joint trim.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

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3.2 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.3 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

**SECTION 10 22 00
OPERABLE PARTITION SYSTEMS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Top-supported sliding panel partitions, horizontal opening.
- B. Top-supported operable panel partitions, vertical opening, electrical operation.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking and track support shimming.

1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- E. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- F. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.
- C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.
- D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, location and details of pass door and frame, adjacent construction and finish trim, and stacking depth.
- E. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until installation.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within five year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sliding Panel Partitions - Horizontal Opening:
 - 1. Basis of Design: NanaWall PrivaSEE. www.nanawall.com
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Operable Panel Partitions - Vertical Opening:

- 1 1. Basis of Design: Skyfold: Classic 60 Model: www.skyfold.com
- 2 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 SLIDING PANEL PARTITIONS - HORIZONTAL OPENING

- 5 A. Sliding Panel Partitions: All glass, top-hung, single track sliding system with glass and vertical and horizontal acoustic seals.
6 Manufacturer's standard top and bottom rail profiles, with head track, stacking bays, side jambs, with dimensions as shown
7 on Drawings.
- 8 B. Panel Size:
 - 9 1. Overall size as indicated on drawings.
 - 10 2. Single Action End Panel Width:
 - 11 a. 3'-4" and as indicated on drawings.
- 12 C. Panel Finishes:
 - 13 1. Provide aluminum head track, side jambs, hinges, and face and edges of top and bottom rails.
 - 14 a. Brushed Anodized
 - 15 2. Safety Glazing: In compliance with ANSI Z97.1, CPSC 16CFR 1201, and ASTM C1036.
 - 16 a. ½" Acoustically enhanced laminated clear glazing
- 17 D. Sliding Hardware:
 - 18 1. Two (2) unidirectional sliding panel carriers that are attached to each panel with a side adjustable stainless steel cast
19 shoe and a stainless steel ball bearing axle.
 - 20 a. Carriers to be glass fiber reinforced polyamide wheels with memory effect and polyamide bumpers
 - 21 2. Adjustment: Provide system capable of specified amount of adjustments without removing panels from tracks.
- 22 E. End Single Action Panel:
 - 23 1. Offset hinged panel that can swing 170 degrees.
 - 24 2. Standard overhead door closer with hold-open function.
 - 25 3. Tubo100 Push/Pull door handles. Brushed Anodized Finish.
 - 26 4. Tubo100 locking mechanism with full mortise cylinder at hand height into the tubular designed handle. Thumb turn
27 operation from inside and key operation from outside. Brushed Anodized Finish.
- 28 F. Other Locking:
 - 29 1. For between-sliding panels, provide self-activated automatic interlock for floor bolts.
 - 30 2. For floor bolts, provide:
 - 31 a. 1-3/16" deep, adjustable, eccentric floor sockets.
- 32 G. Other Components:
 - 33 1. Horizontal Seals: At top and bottom rails, provide sealing brush with double fins on the inside and self-activated
34 adjustable compression seal on the outside.
 - 35 2. Transparent Vertical Edge Acoustical Seals: Between panels, provide UV resistant edge mounted gaskets.
 - 36 a. Light Transmission (LT): 75 percent or higher per ASTM D1003.
 - 37 3. Vertical Side Jamb Seals: Between side jambs and panels, provide double EPDM seals
- 38 H. Performance:
 - 39 1. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
 - 40 2. Acoustic Performance:
 - 41 a. STC 36
 - 42 b. OITC 30
- 43 I. Fabrication
 - 44 1. Extruded aluminum frame and rail profiles, sliding hardware, locking hardware and handles, and glass to construct
45 sliding glass wall.
 - 46 a. Each unit factory pre-assembled and shipped with all components and installation instructions.
 - 47 b. Exposed work to be carefully matched to produce continuity of line and design with all joints.
 - 48 c. No raw edges visible at joints:

2.3 OPERABLE PANEL PARTITIONS - VERTICAL OPENING

- 51 A. Operable Panel Partition: Vertical opening; individual panels stacked in drive box above ceiling; motor operated. The
52 operable wall shall open and close in a manner similar to an accordion, in that all wall panels fold and unfold at the exact
53 same time, at the exact same rate.
- 54 B. Panel Construction:
 - 55 1. Frame: 16 gage, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded
56 construction, with acoustical insulation fill.
 - 57 2. Panel Properties:
 - 58 b. Weight: 10 lb/sq ft max, not including lifting equipment.

- 1 C. Panel Facing Finish:
- 2 1. Manufacturer – Carnegie Xorel
- 3 2. Style: Switch Embroider
- 4 3. Color: 31
- 5 D. Panel Seals:
- 6 1. Panel to Panel Seals: Tongue and groove configuration, color to match panel finish.
- 7 E. Suspension System:
- 8 1. Guide Rails: Extruded aluminum; 6 inches wide and 6 inches deep.
- 9 2. Guide Rollers: Sealed rollers with hardened steel ball bearings.
- 10 3. Drive Box: Hardened steel construction.
- 11 a. Supports weight of panels in stacked position.
- 12 F. Performance:
- 13 1. Acoustic Performance:
- 14 a. A completely functioning operable wall, tested in full accordance and compliance with ASTM E90 (ISO 140-3),
- 15 shall achieve, from an independent laboratory, a Sound Transmission Class (STC) rating (Rw value) of not less
- 16 than the following:
- 17 i. System STC 60 (Rw 59), Panel Construction STC 66 (Rw 64)
- 18 2. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.
- 19 G. Operation:
- 20 1. Electric Operator: 5 to 10 feet per minute vertical traveling speed.
- 21 a. Drive system includes drive shafts, couplers, torque limiter, key pressure actuation control station wired in
- 22 series, dual drive emergency operation and all necessary equipment for electric operation.
- 23 b. Chain drive attaches to dual direction lead panel.
- 24 c. The operable wall shall be designed to have a design life of at least 10,000 complete closed to opened to closed
- 25 cycles.
- 26 2. Control Station: Refer to Electrical and Technology drawings and specifications for incorporation into
- 27 integrated room controls.
- 28 3. Safety Features:
- 29 a. Load Arrestor: Stops free fall occurrence.
- 30 b. Entrapment Backup System: Automatically reverses downward movement when lead edge makes contact with
- 31 obstruction within path of travel.
- 32 c. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
- 33 d. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.
- 34 4. Seals:
- 35 a. The operable wall shall automatically and acoustically seal against the floor without the need for any manual
- 36 intervention. The floor seals shall leave a joint between the floor and the bottom acoustical panels of not more
- 37 than approximately 2".
- 38 b. The operable wall shall automatically and acoustically seal against the two end walls without the need for any
- 39 manual intervention. The end seals shall act in such a way as not to come into contact with the end walls while
- 40 the operable wall is in motion. The end seals shall leave a joint between the acoustical panels and the end
- 41 walls of no more than approximately 1" (25 mm). Seals that rub or brush against the end walls are not
- 42 acceptable. Once the wall reaches the full down position, the end seals shall activate automatically. The key
- 43 switch does not need to be held during the deployment of the ends seals.
- 44 c. The operable wall shall automatically and acoustically seal against the ceiling without any manual intervention.
- 45 The top seals shall leave a joint between the top acoustical panels and the ceiling of the pocket of not more
- 46 than approximately 2"
- 47

PART 3 EXECUTION

3.1 EXAMINATION

- 51 A. Verify that field measurements are as indicated.
- 52 B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.
- 53 C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch of required position and parallel
- 54 to the floor surface.
- 55 D. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.
- 56 E. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.
- 57

- 1 **3.2 INSTALLATION**
2 A. Install partition in accordance with manufacturer's instructions and ASTM E557.
3 B. Install electric operator, wiring, and controls. Locate control station(s) as determined by architect and owner..
4 C. Install acoustic sealant to achieve required acoustic performance.
5 D. Coordinate electrical connections.
6 E. Coordinate flooring anchors, sockets, locks, closers and other accessories that will be recessed in floor with access floor
7 manufacturer. Provide additional material, trim, and accessories to complete installation and provide proper operability.
8
9 **3.3 ADJUSTING**
10 A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic
11 seals.
12 B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
13 C. Adjust partition assembly to achieve lightproof seal.
14
15 **3.4 CLEANING**
16 A. Clean finish surfaces and partition accessories.
17
18 **3.5 CLOSEOUT ACTIVITIES**
19 A. Demonstrate operation of partition and identify potential operational problems.
20
21 **END OF SECTION**
22

SECTION 10 22 29
FULL HEIGHT GLAZED PARTITION SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior all-glass partition system.
- B. Interior all-glass entrance doors.
- C. Fittings, hardware, and accessories for all-glass partition/entrance door system.

1.2 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2017a.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- E. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- F. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- H. GANA (GM) - GANA Glazing Manual; 2009.

1.3 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Manufacturer's descriptive data and performance characteristics.
- C. Shop Drawings: Include plans, elevations, and details showing type and thickness of metal and glass, glazing, anchoring, and joining, hardware, trim, and accessories.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, sidelights, transoms, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- E. Samples:
 - 1. Two (2) samples, 2 inches by 3 inches, minimum, showing actual material and finish of exposed metal components.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Minimum 5 years documented experience in work of this Section.
 - 2. Approved by partition system manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for door installation.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. All-Glass Partition System:
 - 1. Basis of Design; Avanti Systems Inc., Solare Acoustic, Single-Glazed Partition System: www.avantisystemsusa.com

- 1 a. Dorma USA, Inc.: <http://www.dorma.com>
- 2 b. Substitutions: See Section 01 6000 - Product Requirements.
- 3 B. All-Glass Entrance Doors:
- 4 1. Basis of Design; Avanti Systems Inc., Hinged, Glass, Swing Door: www.avantisystemsusa.com
- 5 a. Dorma USA, Inc.: <http://www.dorma.com>
- 6 b. Substitutions: See Section 01 6000 - Product Requirements.
- 7

8 2.2 GLAZED PARTITION SYSTEMS

- 9 A. Aluminum Extrusions:
 - 10 1. ASTM B221 (ASTM B221M), alloy 6063, T6 temper.
 - 11 2. Recycled Content: Minimum 40 percent, with minimum 20 percent classified as post consumer.
 - 12 3. Factory-Applied Polymer Finish: AAMA 2604, polyester powder coating, brushed stainless steel.
 - 13 4. Provide mullions in size and as indicated on drawings. Non-standard vertical mullions to be provided between glazing
 - 14 units on borrowed lights BL-5 and BL-6 as indicated on drawings to reduce deflection to less than 1/175 of clear span
 - 15 or 3/4", whichever is smaller.
 - 16 5. 3-1/2" heavy shoe base to be included at all locations.
- 17 B. Performance:
 - 18 1. Deflection Limits: Deflection normal to glazing plane is limited to 1/175 of clear span or 3/4", whichever is smaller.
 - 19 2. Acoustical performance: 35 STC
- 20 C. Glass:
 - 21 1. Clear Tempered Glass: ASTM C1036, Type 1-Transparent flat, Class 1-Clear, Quality Q3, and fully tempered in
 - 22 accordance with ASTM C1048, Kind FT, thickness 1/2 inch thick.
- 23 D. Swinging Doors:
 - 24 1. Fabricate manufacturer's standard hinged frame swinging doors.
 - 25 2. Provide acoustic door frame.
 - 26 3. Self-closing entrance door standard function with integral hold-open.
- 27 E. Swinging Door Hardware:
 - 28 1. Hinges and closers for doors provided by glass partition system manufacturer.
 - 29 2. Pushes, pulls and other hardware for glass doors provided by glass partition system manufacturer. Coordinate card
 - 30 access controls and power with building system and Electrical and Technology drawings.
 - 31 a. All-Glass Entrance Door Hardware Group 1: Doors 103
 - 32 i. Double doors with closer, hold-open, and storeroom function (Exterior unlocked/locked with key,
 - 33 interior always open)
 - 34 b. All-Glass Entrance Door Hardware Group 2: Doors 105
 - 35 i. Single door with closer, hold-open, and card reader access control with ADA operator
 - 36 c. All-Glass Entrance Door Hardware Group 2: Doors 109, 110, 111, 112, 124
 - 37 i. Single door with closer, hold-open, and card reader access control
 - 38 d. All-Glass Entrance Door Hardware Group 1: Doors 113
 - 39 i. Single door with closer, hold-open, and push/pull hardware
 - 40 3. Refer to Section 08 71 00 Door Hardware for Product Information on mechanical locks and latches, auxiliary locks,
 - 41 electric strikes, lock cylinders, keying, closers, automatic operators, and mechanical stops and holders.
 - 42 4. Hardware finish as specified in Section 08 21 00 Door Hardware.
- 43 F. Accessories: Provide manufacturer's standard accessory materials listed below.
 - 44 1. Concealed fasteners, anchors and attachments.
 - 45 2. Mounting and reinforcing brackets
 - 46 3. Junction clips.
 - 47 4. Reducers and adapters.
 - 48 5. Infill and trim.
- 49

50 PART 3 EXECUTION

51 3.1 EXAMINATION

- 52 A. Verify that openings are acceptable.
- 53 B. Do not begin installation until substrates and openings have been properly prepared.
- 54 C. If substrate preparation is the responsibility of another installer or trade, notify Architect of unsatisfactory or detrimental
- 55 conditions before proceeding.
- 56

- 1 **3.2 INSTALLATION**
2 A. Install in accordance with manufacturer's instructions and approved shop drawings.
3 B. Install components plumb and level, in proper plane, free from warp and twist.
4 C. Install glass and accessories in accordance with GANA Glazing Manual.
5
6 **3.3 ADJUSTING**
7 A. Adjust doors to operate correctly, without binding to frame, sill or adjacent doors.
8 B. Adjust door hardware for smooth operation.
9
10 **3.4 CLEANING**
11 A. Clean installed work to like-new condition.
12 B. Touch up minor scratches and abrasions to match original finish.
13
14 **3.5 PROTECTION**
15 A. Protect installed products until completion of project.
16 B. Touch-up, repair or replace products damaged before Date of Substantial Completion.
17
18 **END OF SECTION**
19

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SECTION 10 26 00
WALL PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Corner guards.
- B. Protective wall covering.

1.2 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Corner guards fabricated from rolled metal sections or bent plate.
- B. Section 05 5000 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
- C. Section 06 1000 - Rough Carpentry: Blocking for wall and corner guard anchors.
- D. Section 09 2116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.
- E. Section 09 2216 - Non-Structural Metal Framing: Placement of supports in stud wall construction.

1.3 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010, with Editorial Revision (2015).
- B. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2014.
- C. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2014.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in City of Madison's name and registered with manufacturer.
- D. Maintenance Materials: Furnish the following for City of Madison's use in maintenance of project:
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Protect work from UV light damage.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Corner Guards:
 - 1. Basis of Design: Inpro: 1 1/2" Wing Surface Mount, 16GA Stainless Steel: www.inprocorp.com.
 - 2. Babcock-Davis; www.babcockdavis.com/#SLE.
 - 3. Construction Specialties, Inc; www.c-sgroup.com.
 - 4. Koroseal Interior Products; www.koroseal.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Protective Wall Protection:
 - 1. Basis of Design: Inpro: Palladium Rigid Sheet: www.inprocorp.com.
 - 2. Construction Specialties, Inc; www.c-sgroup.com.
 - 3. Pawling Corp; www.pawling.com.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for conformance to applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance conforming to applicable provisions of ASTM D543.

1 **2.3 PRODUCT TYPES**

- 2 A. Corner Guards: (CG-1) - Surface Mounted: Refer to Interior Finish Specification on A600.
3 1. Material: Type 304 stainless steel, No. 4 finish, 16 gage, 1/8 inch thick.
4 2. Width of Wings: 1 1/2 inches.
5 3. Corner: Square.
6 5. Length: One piece.
7 B. Protective Wall Protection: (WP-1) Refer to Interior Finish Specification on A600.
8 1. Thickness: 0.040 inch.
9 2. Provide color matching inside, outside, panel divider, and termination trim.
10 C. Adhesives and Primers: As recommended by manufacturer.
11 D. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.
12 E. See Section 06 1000 for wood blocking for wall and corner guard anchors.
13

14 **2.4 FABRICATION**

- 15 A. Fabricate components with tight joints, corners and seams.
16

17 **PART 3 EXECUTION**

18
19 **3.1 EXAMINATION**

- 20 A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
21

22 **3.2 INSTALLATION**

- 23 A. Position corner guard 4 inches above finished floor to ceiling inches high.
24 B. Position protective wall covering no less than 1 inch above finished floor to allow for floor level variation.
25 1. Apply adhesive with 1/8 inch V-notch trowel to an area of wall surface that can be completed within cure time of the
26 adhesive.
27 2. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
28

29 **3.3 CLEANING**

- 30 A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.
31

32 **END OF SECTION**
33

**SECTION 10 2800
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Under-lavatory pipe supply covers.
- D. Diaper changing stations.
- E. Utility room accessories.

1.2 RELATED REQUIREMENTS

- A. Section 09 2116: Concealed supports for accessories, including in wall framing and plates, and above ceiling framing.
- B. Section 08 8300 - Mirrors: Other mirrors.
- C. Section 09 3000 - Tiling: Ceramic washroom accessories.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008 (Reapproved 2013).
- E. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2015.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- G. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004, with Editorial Revision (2016).
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.5 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 5 keys for each accessory to City of Madison; master key lockable accessories.
- C. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

2.2 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.3 Commercial Toilet Accessories

- A. Toilet Paper Dispenser: Jumbo Double roll, surface mounted, smoke/gray finish.
 - 1. Products:
 - a. No Exceptions Taken: Kimberly Clark; 9551.
 - 1) <https://www.kcprofessional.com>.
- B. Paper Towel Dispenser: Electric, roll paper type.
 - 1. Cover: Transparent. Smoke
 - 2. Paper Discharge: Touchless automatic.
 - 3. Capacity: 8 inch diameter roll.
 - 4. Mounting: Surface mounted.
 - 5. Power: Battery operated.

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- 6. Refill Indicator: Illuminated refill indicator.
 - 7. Products:
 - a. No Exceptions Taken: Kimberly Clark, 9992 Electronic Touchless Towel Dispenser
1) <https://www.kcprofessional.com>.
 - C. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted
 - 1. Owner Furnished, Contractor Installed
 - D. Air Freshener Dispenser: Wall-mounted, battery operated.
 - E. Mirrors: Refer to Section 08 8300 – Mirrors.
 - F. Grab Bars: Satin stainless steel, nonslip grasping surface finish.
 - 1. Heavy Duty Grab Bars: Floor supports are not acceptable.
 - a. Push/Pull Point Load: Minimum 1000 pound-force, minimum.
 - b. Dimensions: 1-1/2 inch outside diameter, minimum 0.125 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - G. Sharps Disposal: Satin stainless steel, surface-mounted. Door equipped with full-length stainless steel piano-hinge at bottom; swings down for easy replacement of sharps container. Include Sharps Collector.
 - 1. Products:
 - a. Basis of Design: Bobrick B-350169 Surface-Mounted Sharp Disposal w/ Collector
<http://www.bobrick.com>
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - H. Sanitary Napkin Disposal Unit: Satin stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Products:
 - a. Basis of Design: Bobrick B-270 ConturaSeries Surface-Mounted Sanitary Napkin Disposal.
<http://www.bobrick.com>
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - I. Hook: Heavy-duty satin stainless steel, double-prong, bracket and backplate for concealed attachment, satin finish.
 - 1. Products:
 - a. Bobrick B-6827 Hat and Coat Hook.
<http://www.bobrick.com>.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.4 Commercial Shower and Bath Accessories

- A. Shower Curtain Rod: Satin stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for concealed mounting.
 - 1. Products:
 - a. Basis of Design: Bobrick B-6107 x 36 ClassicSeries.
<http://www.bobrick.com>
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Size: 48 by 72 inches, hemmed edges.
 - 3. Products:
 - a. Basis of Design: Bobrick 204-2 Shower Curtain and 204-1 Shower Curtain Hooks.
<http://www.bobrick.com>.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Folding Shower Seat: Wall-mounted recessed; welded tubular seat frame, structural support members, hinges and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of color as selected.
 - 2. Size: ADA Standards compliant.
 - 3. Products:
 - a. Basis of Design: Bobrick B-5181Reversible Folding Shower Seat.
<http://www.bobrick.com>
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- D. Robe Hook: Heavy-duty satin stainless steel, double-prong, bracket and backplate for concealed attachment, satin finish.
 - 1. Products:
 - a. Bobrick B-6827 Hat and Coat Hook.
<http://www.bobrick.com>.

- 1 b. Substitutions: See Section 01 6000 - Product Requirements.
2

3 **2.5 UNDER-LAVATORY PIPE AND SUPPLY COVERS**

- 4 A. Under-Lavatory Pipe and Supply Covers:
5 1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to
6 comply with ADA Standards.
7 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
8 3. Construction: 1/8 inch flexible PVC.
9 a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less,
10 when tested in accordance with ASTM E84.
11 4. Color: White.
12

13 **2.6 Electric Hand/Hair Dryers**

- 14 A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
15 1. Operation: Automatic, sensor-operated on and off.
16 2. Mounting: Surface mounted.
17 3. Cover: Per Hand Dryer mfr. listed below.
18 a. Color: Per Hand Dryer mfr. listed below.
19 b. Tamper-resistant screw attachment of cover to mounting plate.
20 4. Air Velocity: 18,000 linear feet per minute, minimum, at full power.
21 5. Heater: 500 W, minimum, at full power.
22 6. Fan/Heater Control: Field adjustable down to approximately half-speed with corresponding reduction in heat
23 output.
24 7. Runtime: Non-adjustable, 30 seconds.
25 8. Electric Hand Dryer Products:
26 a. No Exceptions Taken: Dyson Airblade V HU02 120v Nickle finish with the stainless steel backing plate DYSAIR
27 964691-1
28

29 **2.7 Diaper Changing Stations**

- 30 A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or
31 exceeding ASTM F2285.
32 1. Material: Satin stainless steel.
33 2. Mounting: Recessed.
34 3. Products:
35 a. Basis of Design: Bobrick KB110-SSRE Horizontal, Recessed Mounted Baby Changing Station.
36 <http://www.bobrick.com>.
37 b. Substitutions: See Section 01 6000 - Product Requirements.
38

39 **2.8 Utility Room Accessories**

- 40 A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
41 1. Holders: 4 spring-loaded rubber cam holders.
42 2. Length: Manufacturer's standard length for number of holders.
43

44 **PART 3 EXECUTION**

45 **3.1 EXAMINATION**

- 46 A. Verify existing conditions before starting work.
47 B. Verify exact location of accessories for installation.
48 C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
49

50 **3.2 INSTALLATION**

- 51 A. Install accessories in accordance with manufacturers' instructions in locations indicated on the drawings.
52 B. Install plumb and level, securely and rigidly anchored to substrate.
53 C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
54

55 **3.3 PROTECTION**

- 56 A. Protect installed accessories from damage due to subsequent construction operations.
57
58

END OF SECTION

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SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire blankets.
- C. Fire extinguisher cabinets.
- D. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Ansul, a Tyco Business; www.ansul.com.
 - 2. Kidde, a unit of United Technologies Corp; www.kidde.com.
 - 3. Nystrom, Inc; www.nystrom.com/sle.
 - 4. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: www.ovalfireproducts.com/#sle.
 - 5. Pyro-Chem, a Tyco Business; www.pyrochem.com.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Ansul, a Tyco Business; www.ansul.com.
 - 2. JL Industries, Inc; www.jlindustries.com.
 - 3. Kidde, a unit of United Technologies Corp; www.kidde.com.
 - 4. Larsen's Manufacturing Co; www.larsensmfg.com.

2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

2.3 FIRE EXTINGUISHER CABINETS

- A. Cabinet Construction: Non-fire rated.
 - 1. Formed primed steel sheet; 0.036 inch thick base metal.
- B. Cabinet Configuration: Semi-Recessed type.
 - 1. Size to accommodate accessories.
 - 2. Trim: Flat Square edge, with 1 3/4 inch wide face.
 - 3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- C. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge and door stop. Vertical narrow glazing door style w/ door pull.
- D. Door Glazing: Acrylic, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
- E. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- F. Finish of Cabinet Exterior Trim and Door: Factory-applied Baked enamel, white color.
- G. Finish of Cabinet Interior: Factory-applied Baked enamel, white color.
- H. Lettering: Provide Red Vertical FIRE EXTINGUISHER letters.

- 58 **2.4 ACCESSORIES**
59 A. Fire Blanket: Fire retardant treated wool; red, 62 by 84 inch size.
60 B. Extinguisher Brackets: Formed steel, chrome-plated.
61

62 **PART 3 EXECUTION**

- 63
64 **3.1 INSTALLATION**
65 A. Install in accordance with manufacturer's instructions.
66 B. Install cabinets plumb and level in wall openings, 48 inches from finished floor to centerline of door pull.
67 C. Place extinguishers in cabinets.
68

69 **END OF SECTION**
70

**SECTION 10 51 00
LOCKERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Phenolic lockers.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood base construction.
B. Section 06 1000 - Rough Carpentry: Wood blocking and nailers.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
D. Samples: Submit two samples 3 by 6 inches in size, of each color scheduled.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Phenolic Lockers:
1. Columbia Lockers, a division of PSiSC; Phenolic Lockers: www.psisc.com/#sle.
2. Foreman Locker Systems: www.foremanlockers.com.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 LOCKER APPLICATIONS

- A. Wardrobe Lockers: Z-tier (2 lockers each with a short and long compartment) solid phenolic lockers, recessed mounted.
1. Width: 12 inches.
2. Depth: 18 inches.
3. Height: 72 inches.
4. Fittings: Hat shelf, 2 coat hooks.
5. Locking: Padlock hasps, for padlocks provided by Owner.

2.3 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
1. Doors: Full overlay, covering full width and height of locker body; square edges.
2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts. Provide filler in same finish a front and scribe to wall where lockers abut a finished wall surface.
4. Ventilation: By holes drilled in tops, bottoms, and intermediate shelves, and by open space between the back of door and locker body.
5. Door Color: To be selected by Architect; allow for 2 different colors.
6. Body Color: Manufacturer's standard white or light color.
7. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
B. Component Thicknesses:
1. Doors: 1/2 inch minimum thickness.
2. Locker Body: One of the following combinations:

- 1 a. Tops, bottoms, and shelves 3/8 inch; sides and backs 5/16 inch; minimum.
- 2 b. Tops, bottoms, and shelves 1/2 inch; sides 3/8 inch; backs 1/4 inch; minimum.
- 3 C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished
- 4 edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
- 5 1. Surface Burning Characteristics: Flame spread index of 75 or less, and smoke developed index of 450 or less; when
- 6 tested in accordance with ASTM E84.
- 7 D. Hinges: Stainless steel, satin finish; minimum of 90 degree opening; either exposed barrel 5-knuckle hinge attached to back
- 8 of door and inside of body with tamperproof screws, or completely concealed cabinetwork style hinge attached with
- 9 tamperproof screws.
- 10 E. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Place and secure on prepared base.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install end panels and filler panels.
- F. Install accessories.
- G. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 56 17
WALL MOUNTED STANDARDS AND SHELVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shelf standards, brackets, and accessories.
- B. Shelves.
- C. See drawings for locations and configurations.

1.2 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Blocking in metal stud walls for attachment of standards.

1.3 REFERENCE STANDARDS

- A. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Shelf Standards and Brackets:
 - 1. Knape & Vogt Manufacturing Company : www.knapeandvogt.com.

2.2 MATERIALS

- A. Heavy Duty Shelf Standards: Double-slotted channel standards for brackets adjustable in 1 inch increments along entire length of standard, drilled and countersunk for screws.
 - 1. Acceptable Product: K&V 85.
 - 2. Load Capacity: Recommended by manufacturer for loading of 300 to 680 pounds per pair of standards.
 - 3. Lengths: As indicated on drawings.
 - 4. Finish: Powder-coated, white; provide screws with matching heads.
 - 5. Brackets: Double tab type, locking into slots; size to suit shelves; same finish as standards.
- B. Laminate Faced Shelves: Particleboard or medium density fiberboard covered with high pressure decorative laminate on both sides.
 - 1. Edge Finish: Matching laminate, all four edges.
 - 2. Substrate Thickness: 3/4 inch, nominal.
 - 3. Laminate: NEMA LD 3 Type HGL.
 - 4. Laminate Color and Pattern: To be selected by architect from manufacture's full range of standard colors.
- C. Fasteners: Screws as recommended by manufacturer for intended application or as otherwise required by project conditions.

2.3 COUNTER SUPPORTS

- A. Counter Supports are specified in Section 06 41 00 Architectural Wood Casework.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Mount standards to solid backing capable of supporting intended loads.

- 57 C. Install brackets, shelving, and accessories.
- 58
- 59

END OF SECTION

SECTION 12 24 00
WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Window shades and accessories.
- B. Electric motor operators.
- C. Motor controls.

1.2 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Substrate for window shade systems.
- B. Section 09 5100 - Acoustical Ceilings: Shade Pockets, pocket closures and accessories.
- C. Section 26 2726 - Wiring Devices: Finish requirements for wall controls specified in this section.

1.3 REFERENCE STANDARDS

- A. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2002a (Reapproved 2010).
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
 - 2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - 1. Motorized Shades: Include power requirements and standard wiring diagrams.
- C. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- D. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- E. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in City of Madison's name and registered with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manual Roller Shades
 - 1. Basis of Design: Lutron, Manual Roller Shades
- B. Motorized Roller Shades, Motors and Motor Controls:
 - 1. Basis of Design: Lutron Electronics Co., Inc; Sivoia QS Roller Shades: www.lutron.com/sle.
- C. Shade Fabric:
 - 1. Refer to Interior Finish Specification on Sheet A600
- D. Housing and Fascia:
 - 1. Clear Anodized

2.2 ROLLER SHADES

- A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories.
 - 1. Size: As indicated on drawings.

- B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Flammability: Pass NFPA 701 large and small tests.
 - 2. Color: To be selected from mfr. full range of colors.
- C. Roller Tubes: As required for type of operation.
- D. Hembars: Designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.

2.3 MOTOR CONTROLS

- A. Control Requirements:
 - 1. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- B. Wall-Mounted Controls: UV stabilized visible parts meeting ASTM D4674; furnished with backlit buttons; provided by shade manufacturer.
 - 1. Control Functions:
 - f. Presets: Provide button(s) as indicated for selection of programmable scenes.
 - i. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
 - ii. 3 Presets: Automatically open controlled shade(s) to set position when button is pressed.
 - ii. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
 - g. Multiple Shade Groups: Provide individual controls for each elevation change within room.
 - h. Refer to Electrical and Technology drawings and specifications for additional information.
 - 2. Finish: Refer to Interior Finish Specification on Sheet A600.
 - 3. Button Engraving: Manufacturer's standard engraving, unless otherwise indicated.
 - 4. Basis of Design: Lutron Electronics, Inc; see Touch QS Model QSWS2 5-Button Wallstation: www.lutron.com/sle.
 - 5. Refer to Electrical drawings and specifications for wiring and Architectural interior elevations for control locations.

2.4 ACCESSORIES

- A. Fascias: Size as required to conceal shade mounting.
- B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.
- C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.5 FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Installation Tolerances:
 - 1. Maximum Offset From Level: 1/16 inch.
- C. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.2 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.3 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.4 CLOSEOUT ACTIVITIES

- A. See Section 01 7900 - Demonstration and Training, for additional requirements.
- B. Demonstration: Demonstrate operation and maintenance of window shade system to City of Madison's personnel.

- 1 **3.5 MAINTENANCE**
- 2 A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- 3

END OF SECTION

4
5

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**SECTION 12 36 00
COUNTERTOPS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Countertops for manufactured casework.
- C. Wall-hung counters and vanity tops.
- D. Window sills.
- E. Trim.
- F. Solid surface shower surrounds.

1.2 RELATED REQUIREMENTS

- A. Section 06 4100 - Architectural Wood Casework.
- B. Section 22 4000 - Plumbing Fixtures: Sinks.

1.3 REFERENCE STANDARDS

- A. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2014.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- C. AWI/AW/MAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- E. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- F. MIA (DSDM) - Dimensional Stone Design Manual; VIII, 2016.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- H. PS 1 - Structural Plywood; 2009.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PART 2 PRODUCTS

2.1 COUNTERTOPS

- A. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
 - 1. Flat Sheet Thickness: Refer to Interior Finish Specification on Sheet A600.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked

- 1 and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout
2 thickness.
- 3 a. Manufacturers: Refer to Interior Finish Specification on Sheet A600.
4 b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the
5 MIA Dimension Stone Design Manual.
6 c. Finish on Exposed Surfaces: Polished.
7 d. Color and Pattern: As indicated on drawings. Refer to Interior Finish Specification on Sheet A600.
8 e. Size, shape, and configuration as indicated on drawings
9 3. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
10

11 2.2. SOLID SURFACE SHOWER SURROUNDS

- 12 A. Solid Surface: Shower wall panels shall be manufactured from polyester/acrylic blended resins with natural filler material.
13 a. Manufacturers: Refer to Interior Finish Specification on Sheet A600.
14 b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the
15 MIA Dimension Stone Design Manual.
16 c. Edge Options: Square
17 d. Color and Pattern: As indicated on drawings. Refer to Interior Finish Specification on Sheet A600.
18 e. Size, shape, and configuration as indicated on drawings.
19

20 2.3 MATERIALS

- 21 A. Wood-Based Components:
22 1. Wood fabricated from old growth timber is not permitted.
23 B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join
24 lengths using metal splines.
25 C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
26

27 2.4 FABRICATION

- 28 A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
29 1. Join lengths of tops using best method recommended by manufacturer.
30 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
31 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture
32 holes.
33 B. Provide back/end splash wherever counter edge abuts vertical surface where indicated on drawings.
34 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
35 2. Height: 4 inches, unless otherwise indicated.
36 C. Solid Surfacing: Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with
37 manufacturer's recommendations and instructions.
38 D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on drawings, finished to match.
39

40 2.5 COUNTER SUPPORTS

- 41 A. Counter Supports are specified in Section 06 41 00 Architectural Wood Casework.
42

43 2.6 GROMMETS

- 44 A. Provide countertop grommets where indicated on drawings. Field drill with designer/architect's approval upon completion
45 of furniture and technology coordination.
46 1. Product: Basis of Design: Mockett, BRV1 – Brava Grommet Set – Small
47 2. Color: Satin Chrome
48 3. Size: Approximately 2-3/8" Diameter
49

50 PART 3 EXECUTION

51 3.1 PREPARATION

- 52 A. Clean surfaces thoroughly prior to installation.
53 B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate
54 under the project conditions.
55
56

- 1 **3.2 INSTALLATION**
2 A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
3 B. Seal joint between back/end splashes and vertical surfaces.
4 C. Install components plumb and level, scribe adjacent finishes, in accordance with approved shop drawings and
5 recommended installation instructions
6 D. Seal joints and corners between vertical wall panels and between vertical wall panels and base.
7

- 8 **3.3 TOLERANCES**
9 A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
10 B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
11 C. Field Joints: 1/8 inch wide, maximum.
12

- 13 **3.4 CLEANING**
14 A. Clean countertops surfaces thoroughly.
15

16 **END OF SECTION**
17

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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.

- 1 6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or
2 modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although
3 other voltages may be encountered.
- 4 B. General:
- 5 1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's
6 responsibilities related to electrical work required for items such as temperature controls,
7 mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for
8 much of the equipment cannot be determined until the systems have been selected and submittals
9 reviewed. Therefore, the electrical drawings show only known wiring related to such items. All
10 wiring not shown on the electrical drawings, but required for mechanical systems, is the
11 responsibility of the Mechanical Contractor.
- 12 2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the
13 Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The
14 Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical
15 Contractor and designate the terminal numbers for correct wiring.
- 16 3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical
17 Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical
18 Contractor unless noted otherwise.
- 19 C. Mechanical Contractor's Responsibility:
- 20 1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor,
21 for example:
- 22 a. Water Cooled Heat Pumps
23 b. VRF Systems
- 24 2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control
25 Contractor is a Subcontractor to the Mechanical Contractor.
- 26 3. Temperature Control Subcontractor's Responsibility:
- 27 a. Wiring of all devices needed to make the Temperature Control System functional.
- 28 b. Verifying any control wiring on the electrical drawings as being by the Electrical
29 Contractor. All wiring required for the Control System, but not shown on the electrical
30 drawings, is the responsibility of the Temperature Control Subcontractor.
- 31 c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical
32 Contractor, where wiring of the equipment is by the Electrical Contractor.
- 33 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
34 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
35 determine a viable layout.
- 36 D. Electrical Contractor's Responsibility:
- 37 1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical
38 Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or
39 Specifications.
- 40 2. Installs and wires all remote control devices furnished by the Mechanical Contractor or
41 Temperature Control Subcontractor when so noted on the Electrical Drawings.

- 1 3. Provides motor control and temperature control wiring, where so noted on the drawings.
- 2 4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon
3 actuation of the Fire Alarm System as indicated and specified in Division 28.
- 4 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
5 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
6 determine a viable layout.

7 **1.4 COORDINATION DRAWINGS**

8 A. Definitions:

- 9 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the
10 sizes and locations, including elevations, of system components and required access areas to ensure
11 that no two objects will occupy the same space.
- 12 a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork,
13 fire protection systems, plumbing piping, hydronic piping, and any item that may impact
14 coordination with other disciplines.
- 15 b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5”
16 and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting,
17 ceiling-mounted devices, and any item that may impact coordination with other
18 disciplines.
- 19 c. Technology trades shall include, but are not limited to, technology equipment, racks,
20 conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway,
21 ceiling-mounted devices, and any item that may impact coordination with other
22 disciplines.
- 23 d. Maintenance clearances and code-required dedicated space shall be included.
- 24 e. The coordination drawings shall include all underground, underfloor, in-floor, in chase,
25 and vertical trade items.
- 26 2. The contractors shall use the coordination process to identify the proper sequence of installation
27 of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated
28 end result, and to provide adequate access for service and maintenance.

29 B. Participation:

- 30 1. The contractors and subcontractors responsible for work defined above shall participate in the
31 coordination drawing process.
- 32 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a
33 complete set of composite electronic CAD coordination drawings that include all applicable trades,
34 and for coordinating the activities related to this process. The Coordinating Contractor for this
35 project shall be the HVAC Contractor.
- 36 a. The Coordinating Contractor shall utilize personnel familiar with requirements of this
37 project and skilled as draftspersons/CAD operators, competent to prepare the required
38 coordination drawings.
- 39 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by
40 other trades. IMEG will provide electronic file copies of ventilation drawings for contractor’s use if
41 the contractor signs and returns an “Electronic File Transfer” waiver provided by IMEG. IMEG will
42 not consider blatant reproductions of original file copies an acceptable alternative for coordination
43 drawings.

- 1 C. General:
- 2 1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E
3 will only review identified conflicts and give an opinion, but will not perform as a coordinator.
- 4 2. A plotted set of coordination drawings shall be available at the project site.
- 5 3. Coordination drawings are not shop drawings and shall not be submitted as such.
- 6 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for
7 each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material,
8 and labor to allow for adjustments in routing of utilities made necessary by the coordination process
9 and to provide a complete and functional system.
- 10 5. The contractors will not be allowed additional costs or time extensions due to participation in the
11 coordination process.
- 12 6. The contractors will not be allowed additional costs or time extensions for additional fittings,
13 reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the
14 drawings and determined necessary through the coordination process.
- 15 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts
16 or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
- 17 8. Changes to the contract documents that are necessary for systems installation and coordination
18 shall be brought to the attention of the A/E.
- 19 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated
20 on the drawings.
- 21 a. Access to mechanical, electrical, technology, and other items located above the ceiling
22 shall be through accessible lay-in ceiling tile areas.
- 23 b. Potential layout changes shall be made to avoid additional access panels.
- 24 c. Additional access panels shall not be allowed without written approval from the A/E at
25 the coordination drawing stage.
- 26 d. Providing additional access panels shall be considered after other alternatives are
27 reviewed and discarded by the A/E and the Owner's Representative.
- 28 e. When additional access panels are required, they shall be provided without additional
29 cost to the Owner.
- 30 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors
31 prior to installing any of the components.
- 32 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the
33 contractor or subcontractor who did not properly identify their work requirements, or installed
34 their work without proper coordination.
- 35 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

- 1 **1.5 QUALITY ASSURANCE**
- 2 A. Contractor’s Responsibility Prior to Submitting Pricing Data:
- 3 1. The Contractor is responsible for constructing complete and operating systems. The Contractor
4 acknowledges and understands that the Contract Documents are a two-dimensional representation
5 of a three-dimensional object, subject to human interpretation. This representation may include
6 imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field
7 coordination items. Such deficiencies can be corrected when identified prior to ordering material
8 and starting installation. The Contractor agrees to carefully study and compare the individual
9 Contract Documents and report at once in writing to the Design Team any deficiencies the
10 Contractor may discover. The Contractor further agrees to require each subcontractor to likewise
11 study the documents and report at once any deficiencies discovered.
- 12 2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding
13 any subcontracts, ordering material, or starting any work with the Contractor’s own employees.
14 Any work performed prior to receipt of instructions from the Design Team will be done at the
15 Contractor’s risk.
- 16 B. Qualifications:
- 17 1. Only products of reputable manufacturers are acceptable.
- 18 2. All Contractors and subcontractors shall employ only workers skilled in their trades.
- 19 C. Compliance with Codes, Laws, Ordinances:
- 20 1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other
21 regulations having jurisdiction.
- 22 2. If there is a discrepancy between the codes and regulations and these specifications, the
23 Architect/Engineer shall determine the method or equipment used.
- 24 3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do
25 not comply with the codes or regulations, he shall inform the Architect/Engineer in writing,
26 requesting a clarification. If there is insufficient time for this procedure, he shall submit with his
27 proposal a separate price to make the system comply with the codes and regulations.
- 28 4. All changes to the system made after letting of the contract, to comply with codes or requirements
29 of inspectors, shall be made by the Contractor without cost to the Owner.
- 30 5. If there is a discrepancy between manufacturer's recommendations and these specifications, the
31 manufacturer's recommendations shall govern.
- 32 6. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards
33 and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is
34 responsible for providing this guarding if it is not provided with the equipment supplied.
- 35 D. Permits, Fees, Taxes, Inspections:
- 36 1. Procure all applicable permits and licenses.
- 37 2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where
38 the work is done, or as required by any duly constituted public authority.
- 39 3. Pay all charges for permits or licenses.
- 40 4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.

- 1 5. Pay all charges arising out of required inspections by an authorized body.
- 2 6. Pay all charges arising out of required contract document reviews associated with the project and
3 as initiated by the Owner or authorized agency/consultant.
- 4 7. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's
5 Laboratories, Inc.
- 6 E. Examination of Drawings:
- 7 1. The drawings for the fire protection work are completely diagrammatic, intended to convey the
8 scope of the work and to indicate the general arrangements and locations of equipment, outlets,
9 etc., and the approximate sizes of equipment.
- 10 2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing
11 of pipes and ducts to best fit the layout of the job.
- 12 3. Scaling of the drawings is not sufficient or accurate for determining these locations.
- 13 4. Where job conditions require reasonable changes in indicated arrangements and locations, such
14 changes shall be made by the Contractor at no additional cost to the Owner.
- 15 5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc.,
16 may not be shown, but where required by other sections of the specifications or required for proper
17 installation of the work, such items shall be furnished and installed.
- 18 6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
- 19 7. Determination of quantities of material and equipment required shall be made by the Contractor
20 from the documents. Where discrepancies arise between drawings, schedules and/or
21 specifications, the greater number shall govern.
- 22 8. Where used in fire protection documents, the word "furnish" shall mean supply for use, the word
23 "install" shall mean connect complete and ready for operation, and the word "provide" shall mean
24 to supply for use and connect complete and ready for operation.
- 25 a. Any item listed as furnished shall also be installed, unless otherwise noted.
- 26 b. Any item listed as installed shall also be furnished, unless otherwise noted.
- 27 F. Field Measurements:
- 28 1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any
29 supports, pipes or ducts.
- 30 G. Electronic Media/Files:
- 31 1. Construction drawings for this project have been prepared utilizing Revit.
- 32 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or
33 copies of the specifications. Specifications will be provided in PDF format.
- 34 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic
35 File Transmittal" form provided by IMEG.
- 36 4. If the information requested includes floor plans prepared by others, the Contractor will be
37 responsible for obtaining approval from the appropriate Design Professional for use of that part of
38 the document.

- 1 5. The electronic contract documents can be used for preparation of shop drawings and as-built
2 drawings only. The information may not be used in whole or in part for any other project.
- 3 6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout
4 drawings or coordination drawings.
- 5 7. The use of these electronic files by the Contractor does not relieve them from their responsibility
6 for coordination of work with other trades and verification of space available for the installation.
- 7 8. The information is provided to expedite the project and assist the Contractor with no guarantee by
8 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility
9 or liability for the Contractor's use of these documents.

10 **1.6 SUBMITTALS**

11 A. Submittals shall be required for the following items, and for additional items where required elsewhere in the
12 specifications or on the drawings.

13 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

14 B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

15 1. Transmittal: Each transmittal shall include the following:

- 16 a. Date
- 17 b. Project title and number
- 18 c. Contractor's name and address
- 19 d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 20 e. Description of items submitted and relevant specification number
- 21 f. Notations of deviations from the contract documents
- 22 g. Other pertinent data

23 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- 24 a. Date
- 25 b. Project title and number
- 26 c. Architect/Engineer
- 27 d. Contractor and subcontractors' names and addresses
- 28 e. Supplier and manufacturer's names and addresses
- 29 f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 30 g. Description of item submitted (using project nomenclature) and relevant specification
31 number
- 32 h. Notations of deviations from the contract documents
- 33 i. Other pertinent data
- 34 j. Provide space for Contractor's review stamps

35 3. Composition:

- 36 a. Submittals shall be submitted using specification sections and the project nomenclature
37 for each item.

- 1 d. All marks and identifications on the submittals shall be unambiguous.
- 2 7. Schedule submittals to expedite the project. Coordinate submission of related items.
- 3 8. Identify variations from the contract documents and product or system limitations that may be
4 detrimental to the successful performance of the completed work.
- 5 9. Reproduction of contract documents alone is not acceptable for submittals.
- 6 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with
7 prior approval from the Architect/Engineer.
- 8 11. Submittals not required by the contract documents may be returned without review.
- 9 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for
10 each product. If the first submittal is incomplete or does not comply with the drawings and/or
11 specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to
12 recheck and handle the additional shop drawing submittals.
- 13 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any
14 equipment for manufacture or shipment.
- 15 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in
16 submittals is not relieved by the Architect/Engineer's approval.
- 17 C. Electronic Submittal Procedures:
- 18 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer,
19 unless a web-based submittal program is used.
- 20 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
- 21 3. Format: Electronic submittals shall be in PDF format only. Submittals that are not legible will be
22 rejected. Do not set any permission restrictions on files; protected, locked, or secured documents
23 will be rejected.
- 24 4. File Names: Electronic submittal file names shall include the relevant specification section number
25 followed by a description of the item submitted, as follows. Where possible, include the transmittal
26 as the first page of the PDF instead of using multiple electronic files.
- 27 a. Submittal file name: 21 XX XX.description.YYYYMMDD
28 b. Transmittal file name: 21 XX XX.description.YYYYMMDD
- 29 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted
30 via a pre-approved method.

31 **1.7 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

- 32 A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to
33 prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any
34 materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- 35 B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- 36 C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the
37 Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment,
38 he/she shall contract with a qualified lifting and rigging service that has similar documented experience.
39 Follow all equipment lifting and support guidelines for handling and moving.

1 D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site
2 prior to bid for path locations and any required building modifications to allow movement of equipment.
3 Contractor shall coordinate his/her work with other trades.

4 **1.8 WARRANTY**

5 A. Refer to Division 01 specification for requirements.

6 **1.9 INSURANCE**

7 A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

8 **1.10 MATERIAL SUBSTITUTION**

9 A. Refer to Division 1 specification for requirements.

10 **1.11 LEED REQUIREMENTS**

11 A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New
12 Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve
13 this rating.

14 B. Refer to Division 1 specification for additional requirements.

15 **1.12 PROJECT COMMISSIONING**

16 A. The Contractor shall work with the Commissioning Agent (CxA) as described in Division 01 specifications, and
17 provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and
18 EAc3 Enhanced Commissioning.

19 **PART 2 - PRODUCTS**

20 NOT APPLICABLE

21 **PART 3 - EXECUTION**

22 **3.1 JOBSITE SAFETY**

23 A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or
24 his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of
25 their obligations, duties and responsibilities including, but not limited to, construction means, methods,
26 sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of
27 the work of construction in accordance with the contract documents and any health or safety precautions
28 required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to
29 exercise any control over any construction contractor or other entity or their employees in connection with
30 their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The
31 Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made
32 additional insureds under the Contractor's general liability insurance policy.

33 **3.2 OPERATION AND MAINTENANCE MANUALS**

34 A. Refer to Division 1 specification for requirements.

1 **3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES**

2 A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all
3 systems installed under this contract per specification 01 79 00.

4 B. The instructions shall include:

- 5 1. Explanation of all system flow diagrams.
6 2. Maintenance of equipment.
7 3. Start-up procedures for all major equipment.
8 4. Description of emergency system operation.

9 C. Minimum hours of instruction for each item shall be:

- 10 1. Sprinkler System(s) - 1 hour.

11 **3.4 SYSTEM COMMISSIONING**

12 A. The fire protection systems shall be complete and operating. System start-up, testing, balancing, and
13 satisfactory system performance is the responsibility of the Contractor. This includes calibration and
14 adjustments of all controls, noise level adjustments and final comfort adjustments as required.

15 B. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks,
16 safety shutdowns, controls, and alarms.

17 C. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all
18 systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting,
19 assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship
20 problems, equipment substitution issues or unsatisfactory system performance, including call backs during
21 the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and
22 materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the
23 services are requested. The Contractor shall pay the Owner for services required that are product, installation
24 or workmanship related. Payment is due within 30 days after services are rendered.

25 **3.5 RECORD DOCUMENTS**

26 A. The following paragraph supplements Division 1 requirements:

27 Contractor shall maintain at the job site a separate and complete set of fire protection drawings and
28 specifications on which he shall clearly and permanently mark in complete detail all changes made to the fire
29 protection systems.

30 B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations
31 of other control devices, and other units requiring periodic maintenance or repair; actual equipment
32 locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed
33 equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control
34 devices located and numbered, concealed unions located, and with items requiring maintenance located;
35 Change Orders; concealed control system devices.

36 C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials
37 used.

38 D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at
39 any normal work time.

40 E. Upon completing the job, and before final payment is made, give the marked-up drawings to the
41 Architect/Engineer. Refer to 01 78 39 for additional requirements.

1 F. Refer to

2 **3.6 ADJUST AND CLEAN**

3 A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all
4 foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.

5 B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

6 C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

7 **3.7 CONSTRUCTION WASTE MANAGEMENT**

8 A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements
9 outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as
10 referenced in these specifications).

11 1. This Contractor shall coordinate with the General Contractor to develop and implement a
12 construction waste management plan that, at a minimum, identifies the materials to be diverted
13 from disposal and whether the materials will be sorted on-site or co-mingled.

14 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process
15 for all materials associated with this Contractor's scope of work. The Contractor shall provide this
16 information to the General Contractor so that it can be incorporated with similar information from
17 all other contractors for the project.

18 a. Calculations for waste and recycled material can be done by weight or volume, but they
19 must be consistent throughout the project. The Contractor shall coordinate with the
20 General Contractor to establish the preferred calculation method and report the results
21 accordingly.

22 b. Excavated soil and land-clearing debris do not count towards the waste disposal or
23 recycled material.

24 3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or
25 salvaged.

26 **END OF SECTION**

1 READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

2 In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion
3 status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following
4 is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

- 5 1. Penetrations fire sealed and labeled in accordance with specifications.
6 2. Fire protection system operational.
7 3. Pipes labeled.

8 Accepted by:

9 Prime Contractor _____

10 By _____ Date _____

11 Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign
12 this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

13 It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and
14 observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time
15 and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

16 * * * * *

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SECTION 21 05 03
THROUGH PENETRATION FIRESTOPPING

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Through-Penetration Firestopping.

6 **1.2 QUALITY ASSURANCE**

- 7 A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- 8 B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for
9 installation.

10 **1.3 DELIVERY, STORAGE, AND HANDLING**

- 11 A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect
12 for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or
13 other causes. Follow manufacturer's instructions for storage.
- 14 B. Install material prior to expiration of product shelf life.

15 **1.4 PERFORMANCE REQUIREMENTS**

- 16 A. General: For penetrations through the following fire-resistance-rated constructions, including both empty
17 openings and openings containing penetrating items, provide through-penetration firestop systems that are
18 produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke
19 and other gases, and maintain original fire-resistance rating of construction penetrated.

- 20 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
- 21 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling
22 membranes of roof/ceiling assemblies.

- 23 B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL
24 1479:

- 25 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not
26 less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- 27 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with
28 T-ratings indicated, as well as F-ratings:

- 29 a. Floor penetrations located outside wall cavities.
- 30 b. Floor penetrations located outside fire-resistance-rated shaft enclosures.

- 31 C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide
32 products that, after curing, do not deteriorate when exposed to these conditions both during and after
33 construction.

- 34 D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-
35 developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- 36 E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-
37 developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

- 1 F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants
2 used on the interior of the building must comply with the following requirements:
- 3 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management
4 District (SCAQMD) Rule #1168.
- 5 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36
6 requirements in effect on October 19, 2000.

7 **1.5 WARRANTY**

- 8 A. Provide one year warranty on parts and labor.
- 9 B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion
10 resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability,
11 or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of
12 the material.

13 **PART 2 - PRODUCTS**

14 **2.1 MANUFACTURERS**

- 15 A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems
16 indicated for each application that are produced by one of the following manufacturers. All firestopping
17 systems installed shall be provided by a single manufacturer.
- 18 1. 3M; Fire Protection Produces Division.
19 2. Hilti, Inc.
20 3. RectorSeal Corporation, Metacaulk.
21 4. Tremco; Sealant/Weatherproofing Division.
22 5. Johns-Manville.
23 6. Specified Technologies Inc. (S.T.I.)
24 7. Spec Seal Firestop Products
25 8. AD Firebarrier Protection Systems

26 **2.2 THROUGH PENETRATION FIRESTOP SYSTEMS**

- 27 A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping
28 equal to time rating of construction being penetrated.
- 29 B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require
30 hazardous waste removal.
- 31 C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and
32 contraction.
- 33 D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- 34 E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor
35 loading or traffic.
- 36 F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- 37 G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through
38 all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock
39 Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size
40 and material and shall fall within the range of numbers listed:

- 1 1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
2 F Rating = Floor/Wall Rating
3 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
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

- 4 2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
5 F Rating = Wall Rating
6 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

- 7 3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
8 F Rating = Wall/Floor Rating
9 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

10 *Alternate method of firestopping is patching opening to match original rated construction.

- 11 H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the
12 firestopping manufacturer.

- 1 I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance
2 Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the
3 Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

4 **PART 3 - EXECUTION**

5 **3.1 EXAMINATION**

6 A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean
7 and repair surfaces as required. Remove laitance and form-release agents from concrete.

8 B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping
9 systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing
10 firestopping systems.

11 C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey
12 system substrate criteria.

13 D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer.
14 Confine primer to area of bond.

15 **3.2 INSTALLATION**

16 A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items.
17 Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall
18 consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate
19 method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped
20 immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock
21 Hersey listed firestopping system is installed.

22 B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock
23 Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

24 C. Install dams as required to properly contain firestopping materials within openings and as required to achieve
25 required fire resistance rating. Remove combustible damming after appropriate curing.

26 **3.3 CLEANING AND PROTECTING**

27 A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials
28 that are approved in writing by through-penetration firestop system manufacturers and that do not cause
29 damage.

30 B. Provide final protection and maintain conditions during and after installation that ensure that through-
31 penetration firestop systems are without damage or deterioration at time of Substantial Completion. If,
32 despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-
33 penetration firestop systems immediately and install new materials to produce systems complying with
34 specified requirements.

35 **3.4 IDENTIFICATION**

36 A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system
37 supplier and contain the following information in a contrasting color:

- 38 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building
39 Management of Any Damage."

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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 REFERENCES

- A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- B. MSS SP-127 – Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
- C. NFPA 13 - Standard for the Installation of Sprinkler Systems.
- D. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 21 05 00 and Division 01.

1.5 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 supporting steel, copper, and CPVC piping shall conform to the following:

<u>Pipe Size</u>	<u>Rod Size</u>
4" and smaller	3/8"
5", 6", 8"	1/2"
10" and 12"	5/8"

- B. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electroplated zinc finish.

2.2 PIPE HANGERS AND SUPPORTS

- A. General:
 - 1. All pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS-SP-58 and 127 (where applicable).

- 1 B. Vertical Supports:
- 2 1. Support and laterally brace vertical pipes at every floor level in multi-story structures, and more
3 frequently when required by applicable codes, but never at intervals over 15 feet. Support vertical
4 pipes with riser clamps installed below hubs, couplings or lugs. Provide sufficient flexibility to
5 accommodate expansion and contraction without compromising fire barrier penetrations and other
6 fixed takeoff locations.

Acceptable Products:

- Anvil - Fig. CT121
Cooper/B-Line - Fig. B3373CT
Erico - Model 510
Nibco/Tolco - Fig. 82

- 7 2. Wall supports shall be used where vertical height of structure exceeds minimum spacing
8 requirements. Install wall supports at same spacing as hangers or strut supports along vertical
9 length of pipe runs.
- 10 3. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping
11 masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors
12 designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated
13 fasteners, wooden plugs, or plastic inserts.

14 C. Hangers and Clamps:

- 15 1. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate
16 temperature range.
- 17 2. Unless otherwise indicated, hangers shall be as follows:

- 18 a. 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

- 21 b. 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

- 23 3. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter
24 shall be secured to strut with clamps of proper design and capacity as required to maintain spacing
25 and alignment. Strut shall be independently supported from hanger drops or building structure. Size
26 and support shall be per manufacturer's installation requirements for structural support of piping.
27 Clamps shall not interrupt piping insulation.
- 28 4. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc
29 finish.

1 5. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish
2 applied after fabrication.

3 6. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

4 a. Clamp Type:
5 Service: Bare Metal Pipe
6 Rigid Plastic Pipe

7 1) Clamps in direct contact with copper pipe shall be plastic coated.

8 2) Pipes subject to expansion and contraction shall have clamps slightly oversized
9 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	

10 D. Upper (Structural) Attachments:

11 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

12 a. Steel Structure Clamps:

13 1) C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide
14 flanges. Not permitted for use with bar-joists.):

Acceptable Products:

Anvil	Fig. 92
Cooper/B-Line	Fig. B3033/B3034
Erico	Model 300
Nibco/Tolco	68

15 2) Scissor Type Beam Clamps (for use with bar-joists and wide flange):

Acceptable Products:

Anvil	Fig. 228, 292
Cooper/B-Line	Fig. B3054
Erico	Model 360
Nibco/Tolco	Fig. 329

16 b. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per
17 the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified
18 for use in cracked concrete by ACI-355.2.

19 c. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or
20 self-tapping masonry screws. For expansion anchors into hollow concrete block, use
21 sleeve-type anchors designed for the specific application. Do not fasten in masonry joints.
22 Do not use powder actuated fasteners, wooden plugs, or plastic inserts.

- 1 2. Steel Structure Welding:
- 2 a. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu
- 3 of bolting, clamping, or riveting to the building structural frame. Take adequate
- 4 precautions during all welding operations for fire prevention and for protecting walls and
- 5 ceilings from being damaged by smoke.

6 **2.3 FOUNDATIONS, BASES, AND SUPPORTS**

- 7 A. Basic Requirements:
- 8 1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or
- 9 in the Specifications of either the General Construction or Mechanical work as provided by another
- 10 Contractor) for mechanical equipment.
- 11 2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall
- 12 receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel
- 13 supports a final coat of gray enamel.
- 14 B. Supports:
- 15 1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all
- 16 suspended material, equipment and conduit without sag.
- 17 2. Hang heavy equipment from concrete floors or ceilings with Architect-approved concrete inserts,
- 18 furnished and installed by the Contractor whose work requires them, except where indicated
- 19 otherwise.

20 **2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS**

- 21 A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and
- 22 given to the General Contractor for installation or construction as the structure is built.
- 23 B. Coordinate all openings with other Contractors.
- 24 C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing
- 25 structures, or openings in new structures that were not installed, or additional openings. Repair all spalling
- 26 and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to
- 27 ensure even and uniform opening edges.
- 28 D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other
- 29 Contractors shall not exempt the Contractor from providing openings at his expense.
- 30 E. Do not cut structural members without written approval of the Architect or Structural Engineer.

31 **2.5 PIPE SLEEVES AND LINTELS**

- 32 A. Each Contractor shall provide pipe sleeves and lintels for all openings required for the Contractor's work in
- 33 masonry walls and floors, unless specifically shown as being by others.
- 34 B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide
- 35 continuous sleeve. Cut or split sleeves are not acceptable.
- 36 C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all
- 37 lintels approved by the Architect or Structural Engineer.

- 1 D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends
2 extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring
3 closing floor plates.
- 4 E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural
5 Engineer. Sleeves shall then comply with the Engineer's design.
- 6 F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with
7 sufficient annular space around material passing through opening so slight settling will not place stress on the
8 material or building structure.
- 9 G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is
10 responsible for sleeves dislodged or moved when pouring concrete.
- 11 H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint
12 material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration.
13 Secure to prevent shifting during concrete placement and finishing.
- 14 I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation
15 wrapping.

16 **2.6 ESCUTCHEON PLATES AND TRIM**

- 17 A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of
18 finished rooms.
- 19 B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy
20 spring clip, rigid hinge and latch.
- 21 C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction
22 edges of all rectangular openings in finished rooms. This includes duct and pipe openings.

23 **2.7 PIPE PENETRATIONS**

- 24 A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material
25 may be used.
- 26 B. Seal fire rated wall and floor penetrations with fire seal system as specified.

27 **2.8 PIPE ANCHORS**

- 28 A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be
29 supported, guided, aligned, and anchored as required.
- 30 B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

31 **2.9 FINISH**

- 32 A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and
33 suspended ceiling spaces are not considered exposed.

1 **PART 3 - EXECUTION**

2 **3.1 FIRE SUPPRESSION SUPPORTS AND ANCHORS**

3 A. General Installation Requirements:

- 4 1. Install all items per manufacturer's instructions.
- 5 2. Coordinate the location and method of support of piping systems with all installations under other
6 Divisions and Sections of the Specifications.
- 7 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and
8 apply one coat of zinc rich primer to welding.

9 B. Supports Requirements:

- 10 1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method
11 of securing base to roof shall be compatible with roofing materials.
- 12 2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach
13 to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during
14 pipe installation.
- 15 3. Set all concrete inserts in place before pouring concrete.
- 16 4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not
17 shown on the Drawings as being by others.
- 18 5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts
19 and required accessories.
- 20 6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

21 C. Pipe Requirements:

- 22 1. Support all piping and equipment, including valves, strainers, and other specialties and accessories
23 to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or
24 building structure during erection, cleaning, testing and normal operation of the systems.
- 25 2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent
26 proper movement due to expansion and contraction.
- 27 3. Support piping at equipment and valves so they can be disconnected and removed without further
28 supporting the piping.
- 29 4. Piping shall not introduce strains or distortion to connected equipment.
- 30 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and
31 hanger rods; otherwise, pipes shall be supported with individual hangers.
- 32 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
- 33 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers,
34 at equipment connections and heavy fittings.
- 35 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical
36 couplings.

- 1 D. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not
2 extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- 3 E. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof
4 decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include
5 adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved,
6 supplemental framing off steel framing will need to be added.
- 7 F. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- 8 G. Spacing of hangers shall in no case exceed the following:

	<u>Pipe Material</u>	<u>Maximum Spacing</u>
1.	Steel (All steel pipe unless otherwise noted):	
	1-1/4" & under	12'-0"
	1-1/2" & larger	15'-0"
2.	Steel (Schedule 40 lightweight alternative):	
	3" & under	12'-0"

- 9 H. Installation of hangers shall conform to MSS SP-58 and applicable NFPA standards.

10 **END OF SECTION**

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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.

1.2 SUBMITTALS

- A. Submit shop drawings under provisions of Section 21 05 00. Include list of items identified, wording, letter sizes, and color coding.

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>OD 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 Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- C. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.
- 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.
- F. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

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.

1 C. Valves:
 2 1. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with
 3 respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and
 4 Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at
 5 least one corner for easy hanging.

6 D. Pipe Markers:
 7 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady
 8 Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are
 9 acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely
 10 around the pipe.

11 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon
 12 or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

13 3. Stencil Painted Pipe Markers:
 14 a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
 15 b. Apply primer on non-insulated pipes before painting.
 16 c. Use background and letter colors as scheduled later in this section.

17 4. Apply markers and arrows in the following locations where clearly visible:
 18 a. At each valve.
 19 b. On both sides of walls that pipes penetrate.
 20 c. At least every 20 feet along all pipes.
 21 d. On each riser and each leg of each "T" joint.
 22 e. At least once in every room and each story traversed.

23 5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.

24 **3.2 SCHEDULE**

25 A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method
 26 or material is used:

Pipe Service	Lettering Color	Background Color
FIRE PROTECTION WATER	White	Red

27 **END OF SECTION**

**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. Local Fire Department
 - 3. Owner's Insurance Company
- 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.

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.
- B. Provide temporary protective coating on iron and steel valves.
- C. Maintain temporary end caps and closures in place until installation.

1 **1.6 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS**

2 A. Furnish sleeves to General Contractor for placement in walls and floors. Sleeve location to be determined by
3 the Fire Protection Contractor prior to construction. If additional sleeves are required, they shall be core
4 drilled by the Fire Protection Contractor.

5 **1.7 SYSTEM DESCRIPTION**

6 A. System shall cover building areas noted.

7 B. System shall interface with building fire alarm system. Provide all required wiring.

8 C. Extend wet pipe sprinkler system to NFPA 13 and building code requirements as required by Owner's
9 insurance company and as shown on the drawings.

10 **1.8 REGULATORY REQUIREMENTS**

11 A. All material, equipment, and installation shall be approved by the Authorities Having Jurisdiction and the
12 Owner's Insurance Company.

13 B. The Authorities Having Jurisdiction and the Owner's Insurance Company shall have precedence over the
14 drawings and specifications in case of discrepancies.

15 C. The entire installation shall comply with all applicable codes.

16 **1.9 SYSTEM DESIGN**

17 A. Design and install a complete, hydraulically calculated wet-pipe sprinkler system as shown on the fire
18 protection drawings.

19 B. Provide all required equipment and accessories.

20 C. System shall include a 5 psi allowance for future decrease in available pressure and an allowance for inside
21 and outside hose streams.

22 **1.10 COORDINATION DRAWINGS**

23 A. Reference Coordination Drawings article in Section 21 05 00 for required fire protection systems electronic
24 CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

25 **1.11 OPERATION AND MAINTENANCE DATA**

26 A. Submit manufacturers' operation and maintenance data. Include written maintenance data on components
27 of system, servicing requirements, and record drawings.

28 **1.12 JOB CONDITIONS**

29 A. Fire Protection Contractor shall determine the flow and pressure available at the service connection. The Fire
30 Protection Contractor is responsible to verify this information and make all tests required. Base all pipe sizing
31 and hydraulic calculations on flow test data no older than 18 months.

32 B. Pipe sizing shown on drawings for service entrance and main risers is preliminary for coordination purposes
33 only. Contractor is responsible for final sizing from hydraulic calculations.

1 **PART 2 - PRODUCTS**

2 **2.1 PIPE AND FITTINGS**

3 A. Steel Pipe (Inside Building-Above Grade):

4 1. Pipe: 2" and Under - Schedule 40, black steel, ASTM A53. Threaded and coupled or flanged.

5 2. Joints: 2" and under - screwed or flanged.

6 3. Fittings: Screwed - cast iron, 125 lb., black, ANSI/ASME B16.4 or malleable iron, 150 lb., black,
7 ANSI/ASME B16.3. Flanged-cast iron, 125 lb., ANSI/ASME B16.1.

8 B. Steel Pipe (Inside Building-Above Grade):

9 1. Pipe: 2-1/2" and Over - Schedule 10, black steel, grooved, ASTM A135.

10 **2.2 FLEXIBLE SPRINKLER HOSE WITH THREADED END FITTINGS**

11 A. UL listed per UL 2443.

12 B. Construction:

13 1. Hose:

- 14 a. Type 304 stainless steel.
- 15 b. Straight or elbow hose - maximum six (6)-foot hose length.
- 16 c. 1/2" or 3/4" outlet.
- 17 d. 175 psi rated pressure.
- 18 e. Leak-tested minimum 7/8".
- 19 f. Minimum 7/8" hose.
- 20 g. O-ring sealed joints are not acceptable.

21 2. Ceiling Bracket:

- 22 a. Zinc plated or galvanized steel – 24" and 48" sizes.
- 23 b. Flexible hose attachment: Open hub or set screw.

24 3. Unit may be prepackaged with sprinkler head.

25 C. Acceptable Manufacturers: FlexHead Industries, Victaulic Aquaflex.

26 **2.3 UNIONS AND COUPLINGS**

27 A. Unions: 175 psi malleable iron for threaded ferrous piping.

28 B. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, designed to permit some
29 angular and longitudinal deflection; "C" shaped composition sealing gasket, steel bolts, nuts, and washers.
30 175 psi, ASTM A47. Plain end fittings and couplings are not acceptable. Rolled groove couplings for Schedule
31 10 pipe. Cut groove couplings for Schedule 40 pipe. Couplings shall be enamel coated for wet systems.
32 Acceptable Manufacturers: Victaulic, ITT, Grinnell, Central, Star Fittings.

33 C. Coupling gaskets for wet systems shall be Grade "E" EDPM Type A.

34 **2.4 EQUIPMENT**

35 A. Equipment shall be as scheduled on the drawings.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION - PIPING**

3 A. General Installation Requirements:

- 4 1. Coordinate piping and sprinkler locations with all other trades. Ductwork, diffusers and light fixture
5 locations shall have priority over sprinkler piping and sprinklers.
- 6 2. Ream pipe and tube ends to full inside diameter. Remove burrs. Remove scale and foreign material,
7 inside and outside, before assembly.
- 8 3. Die cut screw joints with full cut standard taper pipe threads.
- 9 4. Coat threads with pipe joint compound or wrap with Teflon tape.
- 10 5. Locate piping to minimize obstruction of other work.
- 11 6. Route piping in concealed spaces above finished ceiling.
- 12 7. Use full and double lengths of pipe wherever possible.
- 13 8. Slope all piping for complete drainage. Install auxiliary drains for all trapped piping per NFPA 13.
- 14 9. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the
15 largest pipe shown connecting to it.
- 16 10. Comply with manufacturer's installation instructions.

17 B. Steel Piping:

- 18 1. In steel piping, main sized saddle branch connections or direct connection of branches to main is
19 permitted if main is one pipe size larger than the branch for up to 6" mains and if main is two pipe
20 sizes larger than branch for 8" and larger mains. Do not project branch pipes into main pipes.

21 C. Wall/Floor Penetration:

- 22 1. Provide sleeves when penetrating floors and walls.
- 23 2. Seal pipes passing through exterior walls with a wall seal per Section 21 05 29. Provide Schedule 40
24 galvanized sleeve at least 2 pipe sizes larger than the pipe. Sleeves through floors shall extend
25 minimum 1.5" above finished floor.
- 26 3. Fire seal all pipe and sleeve penetrations (both wall and floor) to maintain fire separation required
27 without restraining pipe.

28 D. Installation Requirements in Electrical Rooms:

- 29 1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes
30 a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth
31 equal to the equipment. Fire protection equipment dedicated to the electrical equipment room or
32 space may be installed above equipment if other alternatives are not available.

33 E. Hangers and Supports:

- 34 1. Provide hangers and supports as required by NFPA 13 and UL/FM, with the following exceptions:
35 a. Do not use powder driven devices, explosive devices, wooden plugs, or plastic inserts.

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SECTION 22 05 00
BASIC PLUMBING REQUIREMENTS

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
6 B. All materials and installation methods shall conform to the applicable standards, guidelines and codes
7 referenced in the specification section.

8 **1.2 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS**

9 A. Definitions:

- 10 1. "Mechanical Contractors" refers to the following:
11 a. Plumbing Contractor.
12 b. Heating Contractor.
13 c. Air Conditioning and Ventilating Contractor.
14 d. Temperature Control Contractor.
15 e. Fire Protection Contractor.
16 f. Testing, Adjusting, and Balancing Contractor.
- 17 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of
18 magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of
19 devices in series with the motor power wiring. In the latter case the devices are usually single phase
20 and are usually connected to the motor power wiring through a manual motor starter having
21 "Manual-Off-Auto" provisions.
- 22 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches,
23 relays, etc., generally represent the types of equipment associated with motor control wiring.
- 24 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be
25 the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts,
26 a control transformer is used to give a control voltage of 120 volts.
- 27 5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper,
28 solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring
29 which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
- 30 a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in
31 voltage (24 volt) in which case a control transformer shall be furnished as part of the
32 temperature control wiring.
- 33 6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or
34 modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although
35 other voltages may be encountered.

36 B. General:

- 37 1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's
38 responsibilities related to electrical work required for items such as temperature controls,
39 mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for
40 much of the equipment cannot be determined until the systems have been selected and submittals

- 1 reviewed. Therefore, the electrical drawings show only known wiring related to such items. All
2 wiring not shown on the electrical drawings, but required for mechanical systems, is the
3 responsibility of the Mechanical Contractor.
- 4 2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the
5 Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The
6 Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical
7 Contractor and designate the terminal numbers for correct wiring.
- 8 3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical
9 Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical
10 Contractor unless noted otherwise.
- 11 C. Mechanical Contractor's Responsibility:
- 12 1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor,
13 for example:
- 14 a. Water Source Heat Pumps
15 b. VRF Systems
- 16 2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control
17 Contractor is a Subcontractor to the Mechanical Contractor.
- 18 3. Temperature Control Subcontractor's Responsibility:
- 19 a. Wiring of all devices needed to make the Temperature Control System functional.
- 20 b. Verifying any control wiring on the electrical drawings as being by the Electrical
21 Contractor. All wiring required for the Control System, but not shown on the electrical
22 drawings, is the responsibility of the Temperature Control Subcontractor.
- 23 c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical
24 Contractor, where wiring of the equipment is by the Electrical Contractor.
- 25 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
26 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
27 determine a viable layout.
- 28 D. Electrical Contractor's Responsibility:
- 29 1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical
30 Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or
31 Specifications.
- 32 2. Installs and wires all remote control devices furnished by the Mechanical Contractor or
33 Temperature Control Subcontractor when so noted on the Electrical Drawings.
- 34 3. Provides motor control and temperature control wiring, where so noted on the drawings.
- 35 4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon
36 actuation of the Fire Alarm System as indicated and specified in Division 28.
- 37 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
38 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
39 determine a viable layout.

1 **1.3 COORDINATION DRAWINGS**

2 A. Definitions:

3 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the
4 sizes and locations, including elevations, of system components and required access areas to ensure
5 that no two objects will occupy the same space.

6 a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork,
7 fire protection systems, plumbing piping, hydronic piping, and any item that may impact
8 coordination with other disciplines.

9 b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5"
10 and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting,
11 ceiling-mounted devices, and any item that may impact coordination with other
12 disciplines.

13 c. Technology trades shall include, but are not limited to, technology equipment, racks,
14 conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway,
15 ceiling-mounted devices, and any item that may impact coordination with other
16 disciplines.

17 d. Maintenance clearances and code-required dedicated space shall be included.

18 e. The coordination drawings shall include all underground, underfloor, in-floor, in chase,
19 and vertical trade items.

20 2. The contractors shall use the coordination process to identify the proper sequence of installation
21 of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated
22 end result, and to provide adequate access for service and maintenance.

23 B. Participation:

24 1. The contractors and subcontractors responsible for work defined above shall participate in the
25 coordination drawing process.

26 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a
27 complete set of composite electronic CAD coordination drawings that include all applicable trades,
28 and for coordinating the activities related to this process. The Coordinating Contractor for this
29 project shall be the HVAC Contractor.

30 a. The Coordinating Contractor shall utilize personnel familiar with requirements of this
31 project and skilled as draftspersons/CAD operators, competent to prepare the required
32 coordination drawings.

33 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by
34 other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if
35 the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will
36 not consider blatant reproductions of original file copies an acceptable alternative for coordination
37 drawings.

38 C. General:

39 1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E
40 will only review identified conflicts and give an opinion, but will not perform as a coordinator.

41 2. A plotted set of coordination drawings shall be available at the project site.

- 1 3. Coordination drawings are not shop drawings and shall not be submitted as such.
- 2 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for
3 each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material,
4 and labor to allow for adjustments in routing of utilities made necessary by the coordination process
5 and to provide a complete and functional system.
- 6 5. The contractors will not be allowed additional costs or time extensions due to participation in the
7 coordination process.
- 8 6. The contractors will not be allowed additional costs or time extensions for additional fittings,
9 reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the
10 drawings and determined necessary through the coordination process.
- 11 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts
12 or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
- 13 8. Changes to the contract documents that are necessary for systems installation and coordination
14 shall be brought to the attention of the A/E.
- 15 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated
16 on the drawings.
- 17 a. Access to mechanical, electrical, technology, and other items located above the ceiling
18 shall be through accessible lay-in ceiling tile areas.
- 19 b. Potential layout changes shall be made to avoid additional access panels.
- 20 c. Additional access panels shall not be allowed without written approval from the A/E at
21 the coordination drawing stage.
- 22 d. Providing additional access panels shall be considered after other alternatives are
23 reviewed and discarded by the A/E and the Owner's Representative.
- 24 e. When additional access panels are required, they shall be provided without additional
25 cost to the Owner.
- 26 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors
27 prior to installing any of the components.
- 28 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the
29 contractor or subcontractor who did not properly identify their work requirements, or installed
30 their work without proper coordination.
- 31 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

32 **1.4 QUALITY ASSURANCE**

- 33 A. Contractor's Responsibility Prior to Submitting Pricing Data:
- 34 1. The Contractor is responsible for constructing complete and operating systems. The Contractor
35 acknowledges and understands that the Contract Documents are a two-dimensional representation
36 of a three-dimensional object, subject to human interpretation. This representation may include
37 imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field
38 coordination items. Such deficiencies can be corrected when identified prior to ordering material
39 and starting installation. The Contractor agrees to carefully study and compare the individual
40 Contract Documents and report at once in writing to the Design Team any deficiencies the
41 Contractor may discover. The Contractor further agrees to require each subcontractor to likewise
42 study the documents and report at once any deficiencies discovered.

- 1 2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding
2 any subcontracts, ordering material, or starting any work with the Contractor's own employees.
3 Any work performed prior to receipt of instructions from the Design Team will be done at the
4 Contractor's risk.
- 5 B. Qualifications:
- 6 1. Only products of reputable manufacturers are acceptable.
- 7 2. All Contractors and subcontractors shall employ only workers skilled in their trades.
- 8 C. Compliance with Codes, Laws, Ordinances:
- 9 1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other
10 regulations having jurisdiction.
- 11 2. Conform to all State Codes.
- 12 3. Conform to Federal Act S.3874 requiring the reduction of lead in drinking water.
- 13 4. If there is a discrepancy between the codes and regulations and these specifications, the
14 Architect/Engineer shall determine the method or equipment used.
- 15 5. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do
16 not comply with the codes or regulations, he shall inform the Architect/Engineer in writing,
17 requesting a clarification. If there is insufficient time for this procedure, he shall submit with his
18 proposal a separate price to make the system comply with the codes and regulations.
- 19 6. All changes to the system made after letting of the contract, to comply with codes or requirements
20 of Inspectors, shall be made by the Contractor without cost to the Owner.
- 21 7. If there is a discrepancy between manufacturer's recommendations and these specifications, the
22 manufacturer's recommendations shall govern.
- 23 8. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards
24 and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is
25 responsible for providing this guarding if it is not provided with the equipment supplied.
- 26 D. Permits, Fees, Taxes, Inspections:
- 27 1. Procure all applicable permits and licenses.
- 28 2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where
29 the work is done, or as required by any duly constituted public authority.
- 30 3. Refer to 00 31 46 for additional details and requirements.
- 31 4. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's
32 Laboratories, Inc.
- 33 E. Examination of Drawings:
- 34 1. The drawings for the plumbing work are completely diagrammatic, intended to convey the scope
35 of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and
36 the approximate sizes of equipment.
- 37 2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing
38 of pipes and ducts to best fit the layout of the job.

- 1 3. Scaling of the drawings is not sufficient or accurate for determining these locations.
- 2 4. Where job conditions require reasonable changes in indicated arrangements and locations, such
3 changes shall be made by the Contractor at no additional cost to the Owner.
- 4 5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc.,
5 may not be shown, but where required by other sections of the specifications or required for proper
6 installation of the work, such items shall be furnished and installed.
- 7 6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
- 8 7. Determination of quantities of material and equipment required shall be made by the Contractor
9 from the documents. Where discrepancies arise between drawings, schedules and/or
10 specifications, the greater number shall govern.
- 11 8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word
12 "install" shall mean connect complete and ready for operation, and the word "provide" shall mean
13 to supply for use and connect complete and ready for operation.
- 14 a. Any item listed as furnished shall also be installed, unless otherwise noted.
- 15 b. Any item listed as installed shall also be furnished, unless otherwise noted.
- 16 F. Field Measurements:
- 17 1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any
18 supports, pipes or ducts.
- 19 G. Electronic Media/Files:
- 20 1. Construction drawings for this project have been prepared utilizing Revit.
- 21 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or
22 copies of the specifications. Specifications will be provided in PDF format.
- 23 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic
24 File Transmittal" form provided by IMEG.
- 25 4. If the information requested includes floor plans prepared by others, the Contractor will be
26 responsible for obtaining approval from the appropriate Design Professional for use of that part of
27 the document.
- 28 5. The electronic contract documents can be used for preparation of shop drawings and as-built
29 drawings only. The information may not be used in whole or in part for any other project.
- 30 6. The drawings prepared by IMEG for bidding purposes may not be used directly for coordination
31 drawings.
- 32 7. The use of these electronic files by the Contractor does not relieve them from their responsibility
33 for coordination of work with other trades and verification of space available for the installation.
- 34 8. The information is provided to expedite the project and assist the Contractor with no guarantee by
35 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility
36 or liability for the Contractor's use of these documents.

1 **1.5 SUBMITTALS**

2 A. Submittals shall be required for the following items, and for additional items where required elsewhere in the
3 specifications or on the drawings.

4 1. Submittals List:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
22 30 00	Water Softeners
Refer to drawings	Plumbing Material List Items

5 B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

6 1. Transmittal: Each transmittal shall include the following:

- 7 a. Date
- 8 b. Project title and number
- 9 c. Contractor's name and address
- 10 d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 11 e. Description of items submitted and relevant specification number
- 12 f. Notations of deviations from the contract documents
- 13 g. Other pertinent data

14 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- 15 a. Date
- 16 b. Project title and number
- 17 c. Architect/Engineer
- 18 d. Contractor and subcontractors' names and addresses
- 19 e. Supplier and manufacturer's names and addresses
- 20 f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 21 g. Description of item submitted (using project nomenclature) and relevant specification
22 number
- 23 h. Notations of deviations from the contract documents
- 24 i. Other pertinent data
- 25 j. Provide space for Contractor's review stamps

26 3. Composition:

- 27 a. Submittals shall be submitted using specification sections and the project nomenclature
28 for each item.
- 29 b. Individual submittal packages shall be prepared for items in each specification section. All
30 items within a single specification section shall be packaged together where possible. An
31 individual submittal may contain items from multiple specifications sections if the items
32 are intimately linked (e.g., pumps and motors).
- 33 c. All sets shall contain an index of the items enclosed with a general topic description on
34 the cover.

35 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings;
36 manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures;
37 performance and test data; wiring and control diagrams; dimensions; shipping and operating
38 weights; shipping splits; service clearances; and all other drawings and descriptive data of materials
39 of construction as may be required to show that the materials, equipment or systems and the
40 location thereof conform to the requirements of the contract documents.

- 1 5. Contractor's Approval Stamp:
- 2 a. The Contractor shall thoroughly review and approve all shop drawings before submitting
3 them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal
4 certifying it has been reviewed.
- 5 b. Unstamped submittals will be rejected.
- 6 c. The Contractor's review shall include, but not be limited to, verification of the following:
- 7 1) Only approved manufacturers are used.
8 2) Addenda items have been incorporated.
9 3) Catalog numbers and options match those specified.
10 4) Performance data matches that specified.
11 5) Electrical characteristics and loads match those specified.
12 6) Equipment connection locations, sizes, capacities, etc. have been coordinated
13 with other affected trades.
14 7) Dimensions and service clearances are suitable for the intended location.
15 8) Equipment dimensions are coordinated with support steel, housekeeping pads,
16 openings, etc.
17 9) Constructability issues are resolved (e.g., weights and dimensions are suitable
18 for getting the item into the building and into place, sinks fit into countertops,
19 etc.).
- 20 d. The Contractor shall review, stamp and approve all subcontractors' submittals as
21 described above.
- 22 e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the
23 Contractor's review of all material and a complete understanding of exactly what is to
24 be furnished. Contractor shall clearly mark all deviations from the contract documents
25 on all submittals. If deviations are not marked by the Contractor, then the item shall be
26 required to meet all drawing and specification requirements.**
- 27 6. Submittal Identification and Markings:
- 28 a. The Contractor shall clearly mark each item with the same nomenclature applied on the
29 drawings or in the specifications.
- 30 b. The Contractor shall clearly indicate the size, finish, material, etc.
- 31 c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall
32 clearly indicate exactly which item and which data is intended.
- 33 d. All marks and identifications on the submittals shall be unambiguous.
- 34 7. Schedule submittals to expedite the project. Coordinate submission of related items.
- 35 8. Identify variations from the contract documents and product or system limitations that may be
36 detrimental to the successful performance of the completed work.
- 37 9. Reproduction of contract documents alone is not acceptable for submittals.
- 38 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with
39 prior approval from the Architect/Engineer.
- 40 11. Submittals not required by the contract documents may be returned without review.

- 1 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for
2 each product. If the first submittal is incomplete or does not comply with the drawings and/or
3 specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to
4 recheck and handle the additional shop drawing submittals.
- 5 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any
6 equipment for manufacture or shipment.
- 7 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in
8 submittals is not relieved by the Architect/Engineer's approval.
- 9 C. Electronic Submittal Procedures:
- 10 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer,
11 unless a web-based submittal program is used.
- 12 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
- 13 3. Format: Electronic submittals shall be in PDF format only. Submittals that are not legible will be
14 rejected. Do not set any permission restrictions on files; protected, locked, or secured documents
15 will be rejected.
- 16 4. File Names: Electronic submittal file names shall include the relevant specification section number
17 followed by a description of the item submitted, as follows. Where possible, include the transmittal
18 as the first page of the PDF instead of using multiple electronic files.
- 19 a. Submittal file name: 22 XX XX.description.YYYYMMDD
20 b. Transmittal file name: 22 XX XX.description.YYYYMMDD
- 21 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted
22 via a pre-approved method.

23 **1.6 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

- 24 A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to
25 prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any
26 materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- 27 B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- 28 C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the
29 Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment,
30 he/she shall contract with a qualified lifting and rigging service that has similar documented experience.
31 Follow all equipment lifting and support guidelines for handling and moving.
- 32 D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site
33 prior to bid for path locations and any required building modifications to allow movement of equipment.
34 Contractor shall coordinate his/her work with other trades.

35 **1.7 WARRANTY**

- 36 A. Refer to Division 01 specification for requirements.

37 **1.8 INSURANCE**

- 38 A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1 **1.9 MATERIAL SUBSTITUTION**

2 A. Refer to Division 01 specification for requirements.

3 **1.10 LEED REQUIREMENTS**

4 A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New
5 Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve
6 this rating.

7 B. Refer to Division 01 specification for LEED credits being attempted on the project.

8 **1.11 PROJECT COMMISSIONING**

9 A. The Contractor shall work with the Commissioning Agent (CxA) as described in Division 01 specifications, and
10 provide all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and
11 EAc3 Enhanced Commissioning.

12 **PART 2 - PRODUCTS**

13 **NOT APPLICABLE**

14 **PART 3 - EXECUTION**

15 **3.1 JOBSITE SAFETY**

16 A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or
17 his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of
18 their obligations, duties and responsibilities including, but not limited to, construction means, methods,
19 sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of
20 the work of construction in accordance with the contract documents and any health or safety precautions
21 required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to
22 exercise any control over any construction contractor or other entity or their employees in connection with
23 their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The
24 Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made
25 additional insureds under the Contractor's general liability insurance policy.

26 **3.2 OPERATION AND MAINTENANCE MANUALS**

27 A. Refer to Division 01 specification for requirements.

28 **3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES**

29 A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all
30 systems installed under this contract per specification 01 79 00.

31 B. The instructions shall include:

32 1. Explanation of all system flow diagrams.

33 2. Maintenance of equipment.

34 3. Start-up procedures for all major equipment.

35 4. Description of emergency system operation.

- 1 C. Minimum hours of instruction for each item shall be:
- 2 1. Domestic Hot Water System - 30 minutes.
- 3 2. Water Softener System - 30 minutes.
- 4 **3.4 SYSTEM COMMISSIONING**
- 5 A. Refer to Division 01 91 00 specification for additional requirements.
- 6 B. The plumbing systems shall be complete and operating. System start-up, testing, balancing, and satisfactory
7 system performance is the responsibility of the Contractor. This includes calibration and adjustments of all
8 controls, noise level adjustments and final adjustments as required.
- 9 C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty
10 period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- 11 D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks,
12 safety shutdowns, controls, and alarms.
- 13 E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all
14 systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting,
15 assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship
16 problems, equipment substitution issues or unsatisfactory system performance, including call backs during
17 the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and
18 materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the
19 services are requested. The Contractor shall pay the Owner for services required that are product, installation
20 or workmanship related. Payment is due within 30 days after services are rendered.
- 21 **3.5 RECORD DOCUMENTS**
- 22 A. The following paragraph supplements Division 1 requirements:
- 23 Contractor shall maintain at the job site a separate and complete set of plumbing drawings and specifications
24 on which he shall clearly and permanently mark in complete detail all changes made to the plumbing systems.
- 25 B. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations
26 devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column
27 lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column
28 lines; mains and branches of piping systems, with valves and control devices located and numbered,
29 concealed unions located, and with items requiring maintenance located; Change Orders; concealed control
30 system devices.
- 31 C. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials
32 used.
- 33 D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at
34 any normal work time.
- 35 E. Upon completing the job, and before final payment is made, give the marked-up drawings to the
36 Architect/Engineer. Refer to 01 78 39 for additional requirements.
- 37 **3.6 ADJUST AND CLEAN**
- 38 A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all
39 foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- 40 B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.

1 C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

2 **3.7 CONSTRUCTION WASTE MANAGEMENT**

3 A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements
4 outlined in LEED MRC2: Construction Waste Management (follow latest edition at the time of bidding or as
5 referenced in these specifications).

6 1. This Contractor shall coordinate with the General Contractor to develop and implement a
7 construction waste management plan that, at a minimum, identifies the materials to be diverted
8 from disposal and whether the materials will be sorted on-site or co-mingled.

9 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process
10 for all materials associated with this Contractor's scope of work. The Contractor shall provide this
11 information to the General Contractor so that it can be incorporated with similar information from
12 all other contractors for the project.

13 a. Calculations for waste and recycled material can be done by weight or volume, but they
14 must be consistent throughout the project. The Contractor shall coordinate with the
15 General Contractor to establish the preferred calculation method and report the results
16 accordingly.

17 b. Excavated soil and land-clearing debris do not count towards the waste disposal or
18 recycled material.

19 3. At a minimum, 50% of the construction and demolition debris for this project must be recycled or
20 salvaged.

21 **END OF SECTION**

1 READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

2 In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion
3 status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following
4 is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

- 5 1. Penetrations fire sealed and labeled in accordance with specifications.
- 6 2. All pumps operating and balanced.
- 7 3. All plumbing fixtures installed and caulked.
- 8 4. Pipe insulation complete, pipes labeled and valves tagged.

9 Accepted by:

10 Prime Contractor _____

11 By _____ Date _____

12 Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign
13 this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

14 It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and
15 observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time
16 and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

17 * * * * *

1
2
SECTION 22 05 03
THROUGH PENETRATION FIRESTOPPING

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Through-Penetration Firestopping.

6 **1.2 QUALITY ASSURANCE**

- 7 A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- 8 B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for
9 installation.

10 **1.3 DELIVERY, STORAGE, AND HANDLING**

- 11 A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect
12 for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or
13 other causes. Follow manufacturer's instructions for storage.
- 14 B. Install material prior to expiration of product shelf life.

15 **1.4 PERFORMANCE REQUIREMENTS**

- 16 A. General: For penetrations through the following fire-resistance-rated constructions, including both empty
17 openings and openings containing penetrating items, provide through-penetration firestop systems that are
18 produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke
19 and other gases, and maintain original fire-resistance rating of construction penetrated.

- 20 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
- 21 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling
22 membranes of roof/ceiling assemblies.

- 23 B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL
24 1479:

- 25 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not
26 less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- 27 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with
28 T-ratings indicated, as well as F-ratings:

- 29 a. Floor penetrations located outside wall cavities.
- 30 b. Floor penetrations located outside fire-resistance-rated shaft enclosures.

- 31 C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide
32 products that, after curing, do not deteriorate when exposed to these conditions both during and after
33 construction.

- 34 D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-
35 developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- 36 E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-
37 developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

- 1 F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants
2 used on the interior of the building must comply with the following requirements:
- 3 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management
4 District (SCAQMD) Rule #1168.
- 5 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36
6 requirements in effect on October 19, 2000.

7 **1.5 WARRANTY**

- 8 A. Provide one year warranty on parts and labor.
- 9 B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion
10 resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability,
11 or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of
12 the material.

13 **PART 2 - PRODUCTS**

14 **2.1 MANUFACTURERS**

- 15 A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems
16 indicated for each application that are produced by one of the following manufacturers. All firestopping
17 systems installed shall be provided by a single manufacturer.
- 18 1. 3M; Fire Protection Produces Division.
19 2. Hilti, Inc.
20 3. RectorSeal Corporation, Metacaulk.
21 4. Tremco; Sealant/Weatherproofing Division.
22 5. Johns-Manville.
23 6. Specified Technologies Inc. (S.T.I.)
24 7. Spec Seal Firestop Products
25 8. AD Firebarrier Protection Systems

26 **2.2 THROUGH PENETRATION FIRESTOP SYSTEMS**

- 27 A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping
28 equal to time rating of construction being penetrated.
- 29 B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require
30 hazardous waste removal.
- 31 C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and
32 contraction.
- 33 D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- 34 E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor
35 loading or traffic.
- 36 F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- 37 G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through
38 all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock
39 Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size
40 and material and shall fall within the range of numbers listed:

- 1 1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
2 F Rating = Floor/Wall Rating
3 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
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

- 4 2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
5 F Rating = Wall Rating
6 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

- 7 3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
8 F Rating = Wall/Floor Rating
9 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

10 *Alternate method of firestopping is patching opening to match original rated construction.

- 11 H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the
12 firestopping manufacturer.

- 1 I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance
2 Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the
3 Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

4 **PART 3 - EXECUTION**

5 **3.1 EXAMINATION**

6 A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean
7 and repair surfaces as required. Remove laitance and form-release agents from concrete.

8 B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping
9 systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing
10 firestopping systems.

11 C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey
12 system substrate criteria.

13 D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer.
14 Confine primer to area of bond.

15 **3.2 INSTALLATION**

16 A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items.
17 Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall
18 consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate
19 method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped
20 immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock
21 Hersey listed firestopping system is installed.

22 B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock
23 Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

24 C. Install dams as required to properly contain firestopping materials within openings and as required to achieve
25 required fire resistance rating. Remove combustible damming after appropriate curing.

26 **3.3 CLEANING AND PROTECTING**

27 A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials
28 that are approved in writing by through-penetration firestop system manufacturers and that do not cause
29 damage.

30 B. Provide final protection and maintain conditions during and after installation that ensure that through-
31 penetration firestop systems are without damage or deterioration at time of Substantial Completion. If,
32 despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-
33 penetration firestop systems immediately and install new materials to produce systems complying with
34 specified requirements.

35 **3.4 IDENTIFICATION**

36 A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system
37 supplier and contain the following information in a contrasting color:

- 38 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building
39 Management of Any Damage."

1 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed;
2 contractor name and phone number; manufacturer’s representative name, address, and phone
3 number.

4 **3.5 INSPECTION**

5 A. All penetrations shall be inspected by the manufacturer’s representative to ensure proper installation.

6 B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their
7 request.

8 C. Proceed with enclosing through-penetration firestop system with other construction only after inspection
9 reports are issued and firestop installations comply with requirements.

10 D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one)
11 to prove compliance with specifications and manufacturer’s instructions and details. Destructive system
12 removal shall be performed by the contractor and witnessed by the engineer and manufacturer’s factory
13 representative. The engineer shall have sole discretion of which firestop system installations will be reviewed.
14 The contractor is responsible for all costs associated with this requirement including labor and material for
15 removing and replacing the installed firestop system. If any firestop system is found to not be installed per
16 manufacturer’s specific instructions and details, all firestop systems are subject to destructive review and
17 replacement at the engineer’s discretion and the contractor’s expense.

18 **END OF SECTION**

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 3-5/8"	1/2"	1/2"
4" and 5"	5/8"	1/2"

Column #1: Steel and 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.

2.2 PIPE AND STRUCTURAL SUPPORTS

- A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58 and 127 (where applicable).

2. 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. Refer to insulation specifications for materials and additional information.

- a. Insulation Couplings:

1) Insulation Coupling: Molded thermoplastic, -65°F to 275°F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb/454kg vertical load rating. On cold pipes operating below 60°F/16°C, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.

- 1 2) Horizontal Strut Mounted Insulated Pipe:
- 2 a) Acceptable Manufacturers: Klo-Shure or equal.
- 3 3) Vertical:
- 4 a) Acceptable Manufacturers: Klo-Shure Titan or equal.
- 5 3. Copper piping located in an exposed area, including indirect waste piping in janitor's closets, shall
6 use split ring standoff hangers for copper tubing. Support shall have copper electroplating for
7 corrosion resistance. Use electro-galvanized or more corrosion resistant and threaded rod for floor
8 applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall
9 applications.

Acceptable Products:

Erico/M-Co	Model #456
B-Line	Fig. 3198HCT
Anvil	Fig. CT138R
Nibco/Tolco	Fig. 301CT

10 B. Vertical Supports:

- 11 1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless
12 otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with
13 riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate
14 expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at
15 fixed takeoff locations.

Acceptable Products:

Cooper/B-Line -	Fig B3373 Series
Erico -	510 Series
Nibco/Tolco -	Fig. 82

- 16 2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold
17 pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over
18 mounts.

19 Acceptable Products: Mason RBA, RCA, or BR.

- 20 3. Wall supports shall be used where vertical height of structure exceeds minimum spacing
21 requirements. Install wall supports at same spacing as hangers or strut supports along vertical
22 length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.

- 23 4. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping
24 masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors
25 designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated
26 fasteners, wooden plugs, or plastic inserts

27 C. Hangers and Clamps:

- 28 1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass
29 through unbroken. This applies to both hot and cold pipes.

- 30 2. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate
31 temperature range. Hydra-Zorb clamps are permitted for this application for bare pipes within their
32 temperature limits of -65°F to +275°F.

- 33 3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

1 4. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each
2 support with a depth not less than specified for the insulation. Factory fabricated inserts may be
3 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

4 5. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid
5 insulation sections may be used.

Acceptable Products:

- Cooper/B-Line - Fig. B3380 through B3384
- Pipe Shields - A1000, A2000
- Erico - Model 124, 127

6 6. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:

- Service: Bare Metal Pipe
Rigid Plastic 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

b. 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

14 7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter
15 shall be secured to strut with clamps of proper design and capacity as required to maintain spacing
16 and alignment. Strut shall be independently supported from hanger drops or building structure. Size
17 and support shall be per manufacturer's installation requirements for structural support of piping.
18 Clamps shall not interrupt piping insulation.

a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-
plated zinc finish.

b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized
finish applied after fabrication.

- 1 8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:
- 2 a. Clamp Type:
- 3 Service: Bare Metal Pipe
- 4 Rigid Plastic Pipe
- 5 Insulated Cold Pipe
- 6 Insulated Hot Pipe - 3 inches and smaller
- 7 1) Clamps in direct contact with copper pipe shall be plastic coated.
- 8 2) Pipes subject to expansion and contraction shall have clamps oversized to allow
- 9 limited pipe movement.

Acceptable Products:	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	

- 10 D. Upper (Structural) Attachments:
- 11 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
- 12 2. Steel Structure Clamps
- 13 a. C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not
- 14 permitted for use with bar-joists):
- | Acceptable Products: | |
|----------------------|------------------|
| Anvil | Fig. 92 |
| Cooper/B-Line | Fig. B3033/B3034 |
| Erico | Model 300 |
| Nibco/Tolco | 68 |
- 15 b. Scissor Type Beam Clamps (For use with bar-joists and wide flange):
- | Acceptable Products: | |
|----------------------|---------------|
| Anvil | Fig. 228, 292 |
| Cooper/B-Line | Fig. B3054 |
| Erico | Model 360 |
| Nibco/Tolco | Fig. 329 |
- 16 c. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per
- 17 the requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified
- 18 for use in cracked concrete by ACI-355.2.
- 19 d. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or
- 20 self-tapping masonry screws. For expansion anchors into hollow concrete block, use
- 21 sleeve-type anchors designed for the specific application. Do not fasten in masonry joints.
- 22 Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- 23 3. Steel Structure Welding:
- 24 a. Unless otherwise noted, hangers, clips, and auxiliary support steel may be welded in lieu
- 25 of bolting, clamping, or riveting to the building structural frame. Take adequate
- 26 precautions during all welding operations for fire prevention and protecting walls and
- 27 ceilings from smoke damage.

1 **2.3 FOUNDATIONS, BASES, AND SUPPORTS**

2 A. Basic Requirements:

- 3 1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or
4 in the Specifications of either the General Construction or Mechanical work as provided by another
5 Contractor) for mechanical equipment.
- 6 2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall
7 receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel
8 supports a final coat of gray enamel.

9 B. Concrete Bases (Housekeeping Pads):

- 10 1. Unless shown otherwise on the drawings, concrete bases shall be nominal 4 inches thick and shall
11 extend 3 inches on all sides of the equipment (6 inches larger than factory base).
- 12 2. Where a base is less than 12 inches from a wall, extend the base to the wall to prevent a "dirt-trap".
- 13 3. Concrete materials and workmanship required for the Contractor's work shall be provided by him.
14 Materials and workmanship shall conform to the applicable standards of the Portland Cement
15 Association. Reinforce with 6"x6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000
16 pounds compression per square inch at 28 days.
- 17 4. Equipment requiring bases is as follows:
- 18 a. Water Heater
19 b. Water Softener

20 C. Supports:

- 21 1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all
22 suspended material, equipment and conduit without sag.
- 23 2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete
24 inserts, furnished and installed by the Contractor whose work requires them, except where
25 indicated otherwise.

26 D. Grout:

- 27 1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise
28 indicated on the drawings or approved by the Architect/Engineer.
- 29 2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
- 30 3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the
31 drawings.

32 **2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS**

33 A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and
34 given to the General Contractor for installation or construction as the structure is built.

35 B. Coordinate all openings with other Contractors.

- 1 C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing
2 structures, or openings in new structures that were not installed, or additional openings. Repair all spalling
3 and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to
4 ensure even and uniform opening edges.
- 5 D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other
6 Contractors shall not exempt the Contractor from providing openings at his expense.
- 7 E. Do not cut structural members without written approval of the Architect or Structural Engineer.

8 **2.5 SLEEVES AND LINTELS**

- 9 A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's
10 work in masonry walls and floors, unless specifically shown as being by others.
- 11 B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide
12 continuous sleeve. Cut or split sleeves are not acceptable.
- 13 C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all
14 lintels approved by the Architect or Structural Engineer.
- 15 D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends
16 extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring
17 closing floor plates.
- 18 E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural
19 Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- 20 F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with
21 sufficient annular space around material passing through opening so slight settling will not place stress on the
22 material or building structure.
- 23 G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is
24 responsible for sleeves dislodged or moved when pouring concrete.
- 25 H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint
26 material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration.
27 Secure to prevent shifting during concrete placement and finishing.
- 28 I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation
29 wrapping.

30 **2.6 ESCUTCHEON PLATES AND TRIM**

- 31 A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of
32 finished rooms.
- 33 B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy
34 spring clip, rigid hinge and latch.
- 35 C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction
36 edges of all rectangular openings in finished rooms. This includes pipe openings.

37 **2.7 PIPE PENETRATIONS**

- 38 A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material
39 may be used.

1 B. Seal fire rated wall and floor penetrations with fire seal system as specified.

2 **2.8 PIPE ANCHORS**

3 A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be
4 supported, guided, aligned, and anchored as required.

5 B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

6 **2.9 FINISH**

7 A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and
8 suspended ceiling spaces are not considered exposed.

9 **PART 3 - EXECUTION**

10 **3.1 PLUMBING SUPPORTS AND ANCHORS**

11 A. General Installation Requirements:

12 1. Install all items per manufacturer's instructions.

13 2. Coordinate the location and method of support of piping systems with all installations under other
14 Divisions and Sections of the Specifications.

15 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and
16 apply one coat of zinc rich primer to welding.

17 B. Supports Requirements:

18 1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method
19 of securing base to roof shall be compatible with roofing materials.

20 2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach
21 to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during
22 pipe installation.

23 3. Set all concrete inserts in place before pouring concrete.

24 4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not
25 shown on the Drawings as being by others.

26 5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts
27 and required accessories.

28 6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.

29 C. Pipe Requirements:

30 1. Support all piping and equipment, including valves, strainers, traps and other specialties and
31 accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in
32 the piping or building structure during erection, cleaning, testing and normal operation of the
33 systems.

34 2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent
35 proper movement due to expansion and contraction.

- 1 3. Support piping at equipment and valves so they can be disconnected and removed without further
2 supporting the piping.
- 3 4. Piping shall not introduce strains or distortion to connected equipment.
- 4 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and
5 hanger rods; otherwise, pipes shall be supported with individual hangers.
- 6 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
- 7 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers,
8 at equipment connections and heavy fittings.
- 9 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical
10 couplings.
- 11 D. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not
12 extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- 13 E. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof
14 decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include
15 adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved,
16 supplemental framing off steel framing will need to be added.
- 17 F. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- 18 G. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall
19 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.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"
3.	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"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"

		<u>Pipe Material</u>	<u>Maximum Spacing</u>
		1-1/2"	10'-0"
		2"	11'-0"
		2-1/2" & larger	12'-0"
1	5.	Rigid Plastic Pipe:	
2	a.	Hangers shall be spaced based on the piping system manufacturers' instructions or, if no	
3		system instructions are available, space hangers at 4'-0" maximum centers.	
4	6.	Installation of hangers shall conform to MSS SP-58 and the applicable Plumbing Code.	
5		END OF SECTION	

**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>OD 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. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

- F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

- G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

- H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

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.

- 1 C. Valves:
- 2 1. All valves (except shutoff valves at equipment) shall have numbered tags.
- 3 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that
4 have been revised.
- 5 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag
6 numbering sequence with the Owner prior to ordering tags.
- 7 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic
8 straps.
- 9 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
- 10 6. Number all tags and show the service of the pipe.
- 11 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with
12 respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and
13 Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at
14 least one corner for easy hanging.
- 15 D. Pipe Markers:
- 16 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady
17 Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are
18 acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely
19 around the pipe.
- 20 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon
21 or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
- 22 3. Stencil Painted Pipe Markers:
- 23 a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
24 b. Apply primer on non-insulated pipes before painting.
25 c. Use background and letter colors as scheduled later in this section.
- 26 4. Apply markers and arrows in the following locations where clearly visible:
- 27 a. At each valve.
28 b. On both sides of walls that pipes penetrate.
29 c. At least every 20 feet along all pipes.
30 d. On each riser and each leg of each "T" joint.
31 e. At least once in every room and each story traversed.
- 32 E. Equipment:
- 33 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an
34 area remote from its function shall have nameplates or plastic tags listing name, function, and
35 drawing symbol. Do not label exposed equipment in public areas.
- 36 2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.
- 37 3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act
38 (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the
39 equipment complies with the requirements of ASHRAE 90.1.

1 **3.2 SCHEDULE**

2 A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method
3 or material is used:

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

4 **END OF SECTION**

1
2
SECTION 22 07 19
PLUMBING PIPING INSULATION

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Piping Insulation.
6 B. Insulation Jackets.

7 **1.2 QUALITY ASSURANCE**

- 8 A. Applicator: Company specializing in piping insulation application with five years minimum experience.
9 B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL
10 723 (where required).
11 C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and
12 sealants used on the interior of the building must comply with the following requirements:
13 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management
14 District (SCAQMD) Rule #1168.
15 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36
16 requirements in effect on October 19, 2000.

17 **1.3 SUBMITTALS**

- 18 A. Submit shop drawings per Section 22 05 00. Include product description, list of materials and thickness for
19 each service, and locations.

20 **PART 2 - PRODUCTS**

21 **2.1 INSULATION**

- 22 A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75°F; non-combustible. All purpose,
23 white kraft jacket bonded to aluminum foil and reinforced with fiberglass yarn, 25/50 flame spread/smoke
24 developed rating when tested in accordance with ASTM E84 (UL 723).
25 B. Type B: Elastomeric cellular foam; ANSI/ASTM C534; flexible plastic; 0.27 maximum 'K' value at 75°F, 25/50
26 flame spread/smoke developed rating when tested in accordance with ASTM E84 (UL 723). Maximum 3/4"
27 thick per layer where multiple layers are specified.
28 C. Type C: Molded rigid cellular glass; ANSI/ASTM C-552; 0.35 maximum 'K' value at 75°F; moisture resistant,
29 non-combustible; suitable for -100°F to +900°F. For below grade installations use asphaltic mastic paper
30 vapor barrier jacket. Use self-seal all-purpose white kraft jacket for above grade installations.

31 **2.2 VAPOR BARRIER JACKETS**

- 32 A. Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at
33 least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket
34 laps and butt strips.
35 B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor
36 resistant. Please refer to manufacturer's recommended installation guidelines.

1 **2.3 JACKET COVERINGS**

2 A. Plastic Jackets and Fitting Covers: High impact, glossy white, 0.030" thick, self-extinguishing plastic.
3 Suitable for use indoors or outdoors with ultraviolet inhibitors. Suitable for -40°F to 150°F. 25/50 maximum
4 flame spread/smoke developed.

5 **PART 3 - EXECUTION**

6 **3.1 PREPARATION**

7 A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying
8 insulation.

9 **3.2 INSTALLATION**

10 A. General Installation Requirements:

11 1. Install materials per manufacturer's instructions, building codes and industry standards.

12 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping.
13 Maintain fire rating of all penetrations.

14 3. On all insulated piping, provide at each support an insert of same thickness and contour as
15 adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging
16 and crushing. The insert shall be suitable for planned temperatures, be suitable for use with
17 specific pipe material, and shall be a 180° cylindrical segment the same length as metal shields.
18 Inserts shall be a cellular glass (for all temperature ranges) or molded hydrous calcium silicate (for
19 pipe with operating temperatures above 70°F), with a minimum compressive strength of 50 psi.
20 Factory fabricated inserts may be used. Rectangular blocks, plugs, or wood material are not
21 acceptable. Temporary wood blocking may be used by the Piping Contractor for proper height;
22 however, these must be removed and replaced with proper inserts by the Insulation Contractor.

23 4. Neatly finish insulation at supports, protrusions, and interruptions.

24 5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be
25 galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold
26 piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or
27 add separate vapor barrier jacket.

28 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
e.	16" to 24"	24" long x 12 gauge

29 7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have
30 written approval from the Authority Having Jurisdiction and the local fire department for
31 authorization and materials approval. If approval has been allowed, the non-rated material shall
32 be wrapped with a product that has passed ASTM E84 and/or NFPA 255 testing with a rating of
33 25/50 or below.

- 1 8. On 1" and smaller piping routed through metal wall studs, provide a plastic grommet to protect
2 the piping. The piping shall be insulated between the wall studs, and the insulation shall butt up
3 to each stud.
- 4 B. Insulated Piping Operating Below 60°F:
- 5 1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and
6 expansion joints. Seal all penetrations of vapor barrier.
- 7 2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses,
8 mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
- 9 3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug
10 wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- 11 C. Insulated Piping Operating Between 60°F and 140°F:
- 12 1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations.
13 Insulate all fittings, valves and strainers.
- 14 D. Exposed Piping:
- 15 1. Locate and cover seams in least visible locations.
- 16 2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the
17 insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco
18 aluminum and shall fit tightly to the insulation.
- 19 3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping does not need to be
20 insulated if less than four feet in developed length. If piping is longer than four feet in developed
21 length, the piping shall be insulated and have a plastic jacket.

22 **3.3 INSULATION**

- 23 A. Type A Insulation:
- 24 1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive
25 adhesive system. Do not staple.
- 26 2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent
27 Chicago Mastic, 3M or Childers lap adhesive.
- 28 3. Apply insulation with laps on top of pipe.
- 29 4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation
30 wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over
31 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure
32 fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For
33 pipes operating below 60°F, seal fitting covers with vapor retarder mastic in addition to tape.
- 34 B. Type B Insulation:
- 35 1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without
36 slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use
37 mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be
38 sealed completely and not pucker or wrinkle. Paint the outside of outdoor insulation with two
39 coats of latex enamel paint recommended by the manufacturer.

- 1 2. Self-seal insulation may be used on pipes operating below 170°F.
- 2 C. Type C Insulation:
- 3 1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a
- 4 similar manner.
- 5 2. Insulate fittings with prefabricated fittings.

6 **3.4 JACKET COVER INSTALLATION**

- 7 A. Plastic Covering:
- 8 1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position
- 9 seams to shed water.
- 10 2. Solvent weld all joints with manufacturer recommended cement.
- 11 3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely.
- 12 Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
- 13 4. All joints in areas noted shall meet USDA standards for Totally Sealed Systems, including overlaps
- 14 of 1" on circumferential and 1.5" to 2" on longitudinal seams.
- 15 5. Use plastic insulation covering on all exposed pipes including, but not limited to:
- 16 a. All exterior piping.
- 17 b. All exposed piping below 8'-0" above floor.
- 18 c. All piping in mechanical rooms and/or tunnels that is subject to damage from normal
- 19 operations. (Example: Piping that must be stepped over routinely.)

20 **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. Plumbing Vents Within 10' from Roof Penetration	A / 1/2"
D. Insulation Inserts at hangers	C - Match pipe insulation thickness

21 **END OF SECTION**

**SECTION 22 09 00
INSTRUMENTATION**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pressure Gauge.
- B. Pressure Gauge Accessories.
- C. Thermometers.
- D. Test Plugs.

1.2 SUBMITTALS

- A. Submit shop drawings per Section 22 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

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.

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.
 - 5. Acceptable Manufacturer: Ashcroft, Marsh, Marshalltown, Miljoco, Tel-Tru, Trerice, U.S. Gauge, Weiss, Weksler, Wika.

1 B. Select scales to cover expected range of temperatures.

2 **2.4 TEST PLUGS**

3 A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving
4 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to
5 500 psi.

6 B. Provide extended units for all plugs installed in insulated piping.

7 C. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

8 **PART 3 - EXECUTION**

9 **3.1 INSTALLATION**

10 A. General Installation Requirements:

11 1. Install per manufacturer's instructions.

12 2. Coil and conceal excess capillary on remote element instruments.

13 3. Install gauges and thermometers in locations where they are easily read from normal operating
14 level.

15 4. Do not install instrumentation when areas are under construction, except for required rough-in,
16 taps, supports and test plugs.

17 B. Pressure Gauges:

18 1. Connect pressure gauges to suction and discharge side of all pumps.

19 2. Provide snubber for each pressure gauge.

20 3. Provide coil syphon for each pressure gauge connected to steam piping.

21 C. Thermometers:

22 1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than
23 2-1/2" for installation of thermometer sockets.

24 2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor
25 sockets.

26 **END OF SECTION**

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**SECTION 22 10 00
PLUMBING PIPING**

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Pipe and Pipe Fittings.
6 B. Valves.
7 C. Domestic Water Piping System.
8 D. Sanitary Drainage and Vent Piping System.
9 E. Storm Drainage Piping System.

10 **1.2 QUALITY ASSURANCE**

- 11 A. Valves: Manufacturer's name and pressure rating marked on valve body. Remanufactured valves are not
12 acceptable.
13 B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.
14 C. Welders Certification: In accordance with ANSI/ASME Sec 9 or ANSI/AWS D1.1.
15 D. Piping, Fittings, Valves, and Flux for Potable Water Systems: All components shall be lead free per Federal
16 Act S.3874, Reduction of Lead in Drinking Water Act.

17 **1.3 SUBMITTALS**

- 18 A. Submit shop drawings per Section 22 05 00.

19 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 20 A. Deliver and store valves in shipping containers with labeling in place.

21 **1.5 COORDINATION DRAWINGS**

- 22 A. Reference Coordination Drawings article in Section 22 05 00 for required plumbing systems electronic CAD
23 drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

24 **PART 2 - PRODUCTS**

25 **2.1 COLD WATER - POTABLE AND NON-POTABLE**
26 **HOT WATER - POTABLE AND NON-POTABLE**

- 27 A. Design Pressure: 175 psi.
28 Maximum Design Temperature: 200°F.
29 B. Piping - All Sizes:
30 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
31 2. Joints: Solder with 100% lead-free solder and flux, ASTM B32.
32 3. Fittings: Wrought copper solder joint, ANSI B16.22.

- 1 C. Shutoff Valves:
- 2 1. Butterfly Valves:
- 3 a. BF-1:
- 4 1) 2-1/2" thru 6", 175 psi CWP, elastomers rated for 20°F to 250°F at 125 psig, fully
5 lugged end, ductile or cast iron body (not in contact with fluid); bronze,
6 aluminum-bronze or EPDM coated ductile iron disc; EPDM seat, stainless steel
7 stem, extended neck, 175 psi bubble-tight, bi-directional dead-end shutoff
8 without backing flange or nuts and with cap screws extending to centerline of
9 valve body (for pipe extension without draining system), 10 position locking
10 operator up to 6" size. Cv of at least 1580 in 6" size. Center Line Series 200,
11 Keystone #222, Watts #DBF-03-121-1P, Stockham LD712-B&3-E, Nibco
12 LD2000N Series, Milwaukee CL series, Hammond 5200 series.
- 13 2. Ball Valves:
- 14 a. BA-1:
- 15 1) 3" and under, 150 psi saturated steam, 600 psi CWP, full port, screwed or solder
16 ends (acceptable only if rated for soldering in line with 470°F melting point of
17 lead-free solder), bronze body of a copper alloy containing less than 15% zinc,
18 stainless steel ball and trim, Teflon seats and seals. Apollo #77C-140, Stockham
19 #S-255-FB-P-UL BR1-R, Milwaukee #BA-400, Watts, Nibco #585-70-66, National
20 Utilities Co., RUB.
- 21 NOTES:
- 22 a) Provide extended shaft for all valves in insulated piping.
- 23 b) Provide lock out trim for all valves opening to atmosphere installed in
24 domestic water piping over 120°F, heating water piping over 120°F,
25 steam, condensate, boiler feed water piping, compressed air piping
26 and gasoline/kerosene piping, and as indicated on the drawings. Solid
27 extended shaft is not required on valves with lock out trim.
- 28 D. Check Valves:
- 29 1. CK-1: 2" and under, 125# steam @ 406°F, 200# CWP @ 150°F, screwed, bronze, horizontal swing.
30 Crane #37, Hammond #IB904, Stockham #B319-Y, Walworth #3406, Milwaukee #509, Watts #G-
31 5000, Nibco T-413B.
- 32 2. CK-14: 2-1/2" thru 12", 200# CWP, double disc wafer type, bronze or iron body, bronze trim, metal-
33 to-metal or Viton seat, 316 SS shaft, Inconel 600 spring. Mission Duo Chek #12HPP (with Inconel
34 springs), Mueller Steam Specialty Co. #71-AHB-K-W, Stockham #WG-961-EPDM or #WG-970-BUNA,
35 Nibco w-920-W.
- 36 3. Joint: Mechanical joint with glands and gaskets and steel bolts. ANSI/AWWAC111/A21.11.
- 37 **2.2 SANITARY DRAINAGE (ABOVE GROUND)**
38 **SANITARY INDIRECT DRAINAGE (ABOVE GROUND)**
39 **SANITARY VENT (ABOVE GROUND)**
40 **STORM DRAINAGE/CLEAR WATER WASTE (ABOVE GROUND)**
41 **CONDENSATE DRAINAGE (ABOVE GROUND)**
- 42 A. Design Pressure: Gravity
43 Maximum Design Temperature: 180°F

- 1 B. Piping - 1-1/2" through 15":
- 2 1. Pipe and Fittings: Standard weight cast iron soil pipe, corrosion protective coating inside and
3 outside, CISPI 301 or ASTM A888.
- 4 2. Joints: Heavy duty, neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp,
5 and screws with at least four screw type clamps, FM 1680 or ASTM C1540.
- 6 3. Adapters: Transitions from cast iron soil pipe to other pipe materials with manufactured adapters.
7 Heavy duty neoprene sleeve gasket, ASTM C-564, 300 Series stainless steel shield, clamp, and
8 screws with not less than four screw type clamps, FM 1680 or ASTM C1540.
- 9 C. Vent Flashing: Flash vents with premolded EPDM pipe flashing cones for single-ply membrane roofs.
- 10 D. Piping that is fully enclosed in walls (not open to the return air plenum system) is allowed to be meet
11 requirements of below ground piping (PVC piping).
- 12 **2.3 SANITARY DRAINAGE (WITHIN RAISED FLOOR AND IN PARKING GARAGE)**
13 **SANITARY VENT (WITHIN RAISED FLOOR AND IN PARKING GARAGE)**
- 14 A. Design Pressure: Gravity
- 15 B. Piping - 1-1/4" through 16" (Maximum Design Temperature: 140°F):
- 16 1. Pipe: Schedule 40 rigid, unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with plain ends,
17 conforming to ASTM Standards D2665 or D2661. Cellular core piping is not acceptable.
- 18 2. Joints: Solvent-weld socket type with solvent recommended by pipe manufacturer.
- 19 3. Fittings: Unplasticized PVC-DWV, or ABS-DWV, normal impact Type I, with solvent-weld socket ends
20 for Schedule 40 pipe.
- 21 4. Use: Use PVC or ABS only where allowed by local jurisdiction. Comply with all special requirements
22 or limitations.
- 23 **2.4 UNIONS**
- 24 A. Copper pipe - wrought copper fitting - ground joint.
- 25 **2.5 AIR VENTS**
- 26 A. Provide means for venting air at all high points in the piping system and at all other points where air may be
27 trapped.
- 28 B. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type,
29 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.
- 30 **2.6 RELIEF VALVES**
- 31 A. RV-4: (Domestic Hot Water) Pressure and Temperature relief, cast bronze body and internal parts, stainless
32 steel spring, test lever, threaded inlet and outlet. Maximum setting of 150 psi and 210°F temperature.
33 Capacities ASME certified and labeled. Acceptable Manufacturers: Cash Series FV, Watts #40, #120, #N240,
34 #340.

1 **2.7 BALANCING VALVE**

- 2 A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a
3 portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a
4 permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with
5 molded, removable insulation covers.
- 6 B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure
7 across a valve). Graph shall extend below the specified minimum flow.
- 8 C. Flow rate of 0.5 GPM or larger: Valves in copper piping shall be brass or bronze. Acceptable Manufacturers:
9 Flow Design "Accusetter", Preso "B+", Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold
10 "Quickset", Gerand "Balvalve Venturi" or Nibco Globe Style balancing valve.
- 11 D. Flow rate less than 0.5 GPM: Valves in copper piping shall be brass or bronze. Cv value shall be less than 1.0
12 when valve is completely open, and minimum balanceable flow rate shall not exceed 0.1 GPM with a meter
13 reading of at least 2.5 feet. Acceptable manufacturers: Bell & Gossett "Circuit Setter RF", Flow Design, Preso,
14 Armstrong, Griswold, Gerand, or Nibco balancing valve.
- 15 E. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on
16 manufacturer's standard meters.

17 **2.8 DRAIN VALVES**

- 18 A. Drain valves shall be shutoff valves as specified for the intended service with added 3/4" male hose thread
19 outlet and cap.

20 **2.9 CONNECTIONS BETWEEN DISSIMILAR METALS**

- 21 A. Connections between dissimilar metals shall be insulating dielectric types that provide a water gap between
22 the connected metals, and that either allow no metal path for electron transfer or that provide a wide water
23 gap lined with a non-conductive material to impede electron transfer through the water path.
- 24 B. Joints shall be rated for the temperature, pressure, and other characteristics of the service in which they are
25 used, including testing procedure.
- 26 C. Aluminum, iron, steel, brass, copper, bronze, and stainless steel are commonly used and require isolation
27 from each other with the following exceptions:
- 28 1. Iron, steel, and stainless steel connected to each other.
- 29 2. Brass, copper, and bronze connected to each other.
- 30 3. Brass or bronze valves and specialties connected in closed systems with steel, iron, or stainless steel
31 on both sides of the brass or bronze valves and specialties. Where two or more brass or bronze
32 items occur together, they shall be connected with brass nipples. Brass or bronze valves and
33 specialties cannot be used as a dielectric separation between pipe materials.
- 34 D. Dielectric protection is required at connections to equipment of a material different than the piping.
- 35 E. Screwed Joints (acceptable up to 2" size):
- 36 1. Dielectric waterway rated for 300 psi CWP and 225°F.
- 37 2. Acceptable Manufacturers: Elster Group ClearFlow fittings, Victaulic Series 47, Grinnell Series 407,
38 Matco-Norca.

- 1 F. Flanged Joints (any size):
- 2 1. Use 1/8" minimum thickness, non-conductive, full-face gaskets.
- 3 2. Employ one-piece molded sleeve-washer combinations to break the electrical path through the
- 4 bolts.
- 5 3. Sleeve-washers are required on one side only, with sleeves minimum 1/32" thick and washers
- 6 minimum 1/8" thick.
- 7 4. Install steel washers on both sides of flanges to prevent damage to the sleeve-washer.
- 8 5. Separate sleeves and washers may be used only if the sleeves are manufactured to exact lengths
- 9 and installed carefully so the sleeves must extend partially past each steel washer when tightened.
- 10 6. Acceptable Manufacturers: EPCO, Central Plastics, Pipeline Seal and Insulator, F. H. Maloney, or
- 11 Calpico.

12 **2.10 LOCK OUT TRIM**

- 13 A. Provide lock out trim for all quarter turn shutoff valves opening to atmosphere and installed in domestic
- 14 water piping over 120°F, in compressed air piping, and as indicated on the drawings.

15 **2.11 VALVE OPERATORS**

- 16 A. Provide handwheels for gate valves and gear operators for butterfly valves.

17 **2.12 VALVE CONNECTIONS**

- 18 A. Provide all connections to match pipe joints. Valves shall be same size as pipe unless noted otherwise.

19 **PART 3 - EXECUTION**

20 **3.1 PREPARATION**

- 21 A. Install all products per manufacturer's recommendations.
- 22 B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- 23 C. Remove scale and dirt, on inside and outside, before assembly.
- 24 D. Connect to equipment with flanges or unions.
- 25 E. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for
- 26 dishwasher drainage or piping that receives boiler blowdown.

27 **3.2 TESTING PIPING**

- 28 A. Sanitary Drainage:
- 29 Sanitary Vent:
- 30 Storm Drainage:
- 31 1. Test all piping with water to prove tight.
- 32 2. Test piping before insulation is applied.

- 1 3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for
2 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
- 3 4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
- 4 5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception:
5 Smoke/air test shall not be performed on plastic piping.
- 6 6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
- 7 7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction,
8 whichever is most stringent.
- 9 B. Hot Water - Potable and Non-Potable:
10 Cold Water - Potable and Non-Potable:
11 Service Water:
- 12 1. Test pipes underground or in chases and walls before piping is concealed.
- 13 2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and
14 a leak develops which ruins the insulation, replace damaged insulation.
- 15 3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen.
- 16 4. Hold test pressure for at least 2 hours.
- 17 5. Test to be witnessed by the Architect/Engineer's representative, if requested by the
18 Architect/Engineer.
- 19 C. All Other Piping:
- 20 1. Test piping at 150% of normal operating pressure.
- 21 2. Piping shall hold this pressure for one hour with no drop in pressure.
- 22 3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use
23 combustible fluids.
- 24 4. Drain and clean all piping after testing is complete.
- 25 **3.3 CLEANING PIPING**
- 26 A. Assembly:
- 27 1. Before assembling pipe systems, remove all loose dirt, scale, oil and other foreign matter on internal
28 or external surfaces by means consistent with good piping practice subject to approval of the
29 Architect/Engineer's representative. Blow chips and burrs from machinery or thread cutting
30 operation out of pipe before assembly. Wipe cutting oil from internal and external surfaces.
- 31 2. During fabrication and assembly, remove slag and weld spatter from both internal and external
32 joints by peening, chipping and wire brushing.
- 33 3. Notify the Architect/Engineer's representative before starting any post erection cleaning in
34 sufficient time to allow witnessing the operation. Consult with and obtain approval from the
35 Architect/Engineer's representative with regard to specific procedures and scheduling. Dispose of
36 cleaning and flushing fluids properly.

1 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment,
2 open wide all valves, and be certain all strainer screens are in place.

3 B. All Water Piping:

4 1. Flush all piping using faucets, flush valves, etc. until the flow is clean.

5 2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.

6 3. If necessary, remove valves to clean out all foreign material.

7 **3.4 INSTALLATION**

8 A. General Installation Requirements:

9 1. Provide dielectric connections between dissimilar metals.

10 2. Route piping in orderly manner and maintain gradient. Install to conserve building space.

11 3. Group piping whenever practical at common elevations.

12 4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.

13 5. Slope water piping and arrange to drain at low points.

14 6. Install bell and spigot piping with bells upstream.

15 7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one
16 coat of zinc rich primer to welds.

17 8. Seal pipes passing through exterior walls with a wall seal per Section 22 05 29. Provide Schedule 40
18 galvanized sleeve at least 2 pipe sizes larger than the pipe.

19 9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8"
20 high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black
21 lettering on a yellow background.

22 10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within
23 a wall cavity, unless specifically noted otherwise to be surface mounted.

24 B. Installation Requirements In Electrical Rooms:

25 1. Do not install piping or other equipment above electrical switchboards or panelboards. This
26 includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and
27 depth equal to the equipment.

28 C. Valves/Fittings and Accessories:

29 1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating
30 any other room or portion of the building. Individual fixture angle stops do not meet this
31 requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.

32 2. Provide clearance for installation of insulation and access to valves and fittings.

33 3. Provide access doors for concealed valves and fittings.

34 4. Install valve stems upright or horizontal, not inverted.

- 1 5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide
2 each plug valve 2-1/2" and larger with a wrench with set screw.
- 3 6. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as
4 required, per manufacturer's installation instructions.
- 5 7. Install corrugated, stainless steel tubing system according to manufacturer's written instructions.
6 Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.
- 7 D. Sanitary and Storm Piping:
- 8 1. Install all sanitary piping inside the building with a slope of at least the following:
- | <u>Pipe Size</u> | <u>Minimum Slope</u> |
|------------------|----------------------|
| 3" and under | - 0.25" per foot |
| 4" and over | - 0.125" per foot |
- 9 a. All sanitary systems transporting grease laden waste shall be sloped a minimum of 0.25"
10 per foot regardless of size.
- 11 2. Install all storm piping inside the building with a slope of at least 0.125" per foot unless noted
12 otherwise.
- 13 3. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
- 14 4. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings
15 and to maintain a minimum velocity of 3 feet per second.
- 16 5. All sanitary and storm piping shall have at least 42" of cover when leaving the building.
- 17 **3.5 PIPE ERECTION AND LAYING**
- 18 A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are
19 unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- 20 B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or
21 nameplates with sufficient data to determine their conformance with specified requirements.
- 22 C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into
23 piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- 24 D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual
25 work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items
26 specifically designed and intended for this purpose.
- 27 E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only
28 offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- 29 F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not
30 use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless
31 otherwise shown on the drawings or specified.
- 32 G. Provide flanges or unions at all final connections to equipment, traps and valves.
- 33 H. Arrange piping and connections so equipment served may be totally removed without disturbing piping
34 beyond final connections and associated shutoff valves.
- 35 I. Use full and double lengths of pipe wherever possible.

- 1 J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other
2 equipment at line size with reduction in size being made only at control valve or equipment.
- 3 K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion
4 loops where cold springing is indicated on the drawings.
- 5 L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Provide and operate
6 sufficient pumping equipment to maintain excavations, trenches and pits free of water. Dispose of pumped
7 water so operation areas and other facilities are not flooded. Pipe laying shall follow excavating as closely as
8 possible.
- 9 M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45° or 90° angle
10 from the horizontal plane for air lines, and from top, bottom or side for liquids.
- 11 **3.6 DRAINING AND VENTING**
- 12 A. Unless otherwise indicated on the drawings, all horizontal water and compressed air lines, including branches,
13 shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- 14 B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets
15 due to changes in elevation.
- 16 C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- 17 D. Provide drip legs at low points and at the base of all risers in compressed air pipes. Drip legs shall be full line
18 size on pipes through 4" and at least 4", but not less than half line size over 4". Drip legs shall be 12" minimum
19 length, capped with a reducer to a drain valve.
- 20 E. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and
21 venting. Install compressed air and gravity drain pipes with bottom of pipe and eccentric reducers in a
22 continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- 23 F. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- 24 G. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8"
25 pipe from the tapping location to an accessible location and terminate with a venting device.
- 26 H. All vent and drain piping shall be of same materials and construction for the service involved.
- 27 **3.7 PLUMBING VENTS**
- 28 A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- 29 **3.8 BRANCH CONNECTIONS**
- 30 A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of
31 the type required for the service.
- 32 B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest
33 pipe shown connecting to it.
- 34 C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.
- 35 D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The
36 branch piping connection shall be brazed connection for the following services only:
- 37 1. Domestic water piping above grade.

1 E. Branch connections from headers and mains may be cut into black steel pipe using forged weld-on fittings.

2 F. Forged weld-on fittings are limited as follows:

3 1. Must have at least same pressure rating as the main.

4 2. Main must be 2-1/2" or larger.

5 3. Branch line is at least two pipe sizes under main size.

6 **3.9 JOINING OF PIPE**

7 A. Solder Joints:

8 1. Make up joints with 100% lead-free solder, ASTM B32. Cut tubing so ends are perfectly square and
9 remove all burrs inside and outside. Thoroughly clean sockets of fittings and ends of tubing to
10 remove all oxide, dirt and grease just prior to soldering. Apply flux evenly, but sparingly, over all
11 surfaces to be joined. Heat joints uniformly so solder will flow to all mated surfaces. Wipe excess
12 solder, leaving a uniform fillet around cup of fitting.

13 2. Flux shall be non-acid type.

14 3. Solder end valves may be installed directly in the piping system if the entire valve is suitable for use
15 with 470°F melting point solder. Remove discs and seals during soldering if they are not suitable
16 for 470°F.

17 B. Solvent Weld Joints (PVC):

18 1. Make joints with a two-step process. Use primer conforming to ASTM F656 and solvent cement
19 conforming to ASTM D2564.

20 C. Sleeve Gaskets (No-Hub) (Sanitary and Storm Pipe):

21 1. Gasket shall be heavy weight class, conforming to ASTM C564.

22 2. The gasket shall have an internal center stop.

23 3. The gasket shall be covered by a stainless steel band secured with a minimum of four stainless steel
24 bands per fitting/joint.

25 4. Sleeve gaskets shall be installed in accordance with the manufacturer's installation instructions.

26 **3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

27 A. Provide necessary connections at the start of individual sections of mains for adding chlorine.

28 B. Before starting work, verify system is complete, flushed and clean.

29 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
30 (hydrochloric).

31 D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80
32 mg/L residual.

33 E. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.

34 F. Verify initial chlorination levels by testing at minimum 15% of outlets located throughout entire building,
35 including the last fixture connected to each main and each branch extending over 50 feet from a main.

- 1 G. Maintain disinfectant in system for 24 hours, after which test at minimum 15% of outlets located throughout
2 entire building, including the last fixture connected to each main and each branch extending over 50 feet
3 from a main. If final disinfectant residual tests less than 25 mg/L at any one of the tested outlets, flush the
4 entire system and repeat disinfection and testing procedure.

- 5 H. After final disinfectant residuals test at or above 25 mg/L after a minimum 24-hour duration, flush disinfectant
6 from system at a minimum velocity of 3.0 feet/second until residual is equal to that of incoming water or 1.0
7 mg/L.

- 8 I. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain,
9 analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

10 **END OF SECTION**

**SECTION 22 10 30
PLUMBING SPECIALTIES**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Floor Drains.
- B. Cleanouts.
- C. Traps.
- D. Backflow Preventers.
- E. Water Hammer Arresters and Air Chambers.

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 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 FLOOR DRAINS AND SINKS

- A. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

1 **2.4 BACKFLOW PREVENTERS**

2 A. Provide backflow preventers as shown and specified on the drawings as well as required by code.

3 **2.5 WATER HAMMER ARRESTERS AND AIR CHAMBERS**

4 A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.

5 B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between
6 -100°F and 300°F and maximum 250 psig working pressure.

7 C. Air chambers shall meet the requirements of the applicable plumbing code. Minimum 12" long at fixtures
8 and minimum 24" long on risers. Air chambers shall be the same size or larger than the piping it is
9 connected to.

10 **PART 3 - EXECUTION**

11 **3.1 INSTALLATION AND APPLICATION**

12 A. Coordinate construction to receive drains at required invert elevations.

13 B. Install all items per manufacturer's instructions.

14 C. Water Hammer Arresters and Air Chambers:

15 1. Install water hammer arresters in accessible locations. Provide access doors as required.
16 Coordinate type with Architect/Engineer/Owner.

17 2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing
18 fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves
19 shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and
20 flush valves, squeeze handle spray faucets, and other similar type valves.

21 3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in
22 developed length from the cold and hot water mains.

23 4. Install air chambers at each fixture not protected by a water hammer arrester.

24 D. Cleanouts:

25 1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther
26 apart than 50 feet in pipe less than 6" size and 75 feet apart in 6" and larger pipes inside the
27 building.

28 2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as
29 required by code.

30 3. Extend cleanouts to the floor with long sweep elbows.

31 4. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite
32 and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.

33 5. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12"
34 above the finished floor.

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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.

1 **PART 2 - PRODUCTS**

2 **2.1 WATER HEATERS**

3 A. All water heaters shall be as scheduled on the drawings.

4 **2.2 COMMERCIAL WATER SOFTENER**

5 A. Automatic duplex water softener to remove hardness to no more than 1.0 grains per gallon as determined
6 by an ASTM Standard Soap Test Method.

7 B. Incoming water contains approximately 21 grains per gallon based on information obtained from the local
8 utility. Obtain a current water sample from the water source serving that will be serving the project and
9 have it analyzed to make sure equipment can perform as designed. Provide report to the
10 Architect/Engineer before providing shop drawings.

11 C. Softener Tanks: Fiberglass reinforced polyester, designed for a minimum working pressure of 100 psig,
12 hydrostatically tested at 150% of working pressure. Sideshell height to allow a minimum freeboard space of
13 50% of the mineral bed depth for adequate expansion during backwashing. Softener tank not over 13 inches
14 diameter, 54 inches sideshell height. Tank bottom will be supported with a molded structural base. The top
15 opening will be 1.5 inches with a threaded connection.

16 D. Distribution System: Soft water collector and backwash distributor, hub and arm radial or healer lateral
17 type lower distribution system. Distribution shall be covered with a single layer of washed inorganic media
18 to evenly distribute the service and backwash water and support the mineral bed tank.

19 E. Brine Tank: Rigid polyethylene or fiberglass with tight fitting cover, size not over 18 inches diameter, 40
20 inches height, corrosion-free elevated salt platform, float-operated plastic fitted brine valve to control brine
21 withdrawal and freshwater refill. The brine valve shall provide positive shutoff to prevent air from entering
22 the system. Brine eductor shall dilute brine flow to softener. Brine shall be provided with a float-operated
23 shutoff valve to keep the tank from overflowing.

24 1. Provide initial fill of brine tank with manufacturer recommended salt product. Tank shall be full at
25 time the Owner is given occupancy.

26 F. Softener Ion Exchange Resin: Virgin, high capacity, standard mesh of sulfonated polystyrene type stable
27 over the entire PH range, with good resistance to bead fracture from attrition or osmotic shock. Solid resin,
28 of the proper particle size of 20 to 50 mesh, U.S. standard screen, and will contain no agglomerates, shells,
29 plates, or other shapes to interfere with normal function of water softener. The system shall include 2 cubic
30 feet of exchange resin per vessel and a total of 4 cubic feet of resin for the system.

31 G. System Efficiency: System shall have minimum efficiency of 4000 grains of hardness removed per pound of
32 salt usage. Include brine reclaim if required to meet the efficiency requirements if normal system does not
33 have this minimum efficiency requirement.

34 H. Pipes, Valves and Fittings: Pipe shall be galvanized, standard weight steel, Type L copper, or Schedule 5
35 stainless steel. Fittings shall be 125 lb. Class malleable iron for steel, Type L for copper, and Schedule 5 for
36 stainless steel. All piping shipped assembled shall be hydrostatically tested for leaks at the factory.

37 I. Water Testing Equipment: Complete with sample cock installed to obtain samples of effluent water.
38 Furnish a complete test kit for conducting soap tests.

39 J. Automatic Controls:

40 1. System design shall use Demand Recall controls.

- 1 2. The main control shall be a fully automatic, top-mounted brass control and sized with 1.5 inch
2 NPT inlet and outlet connections. The top-mounted main control design will be motor driven,
3 mechanically activated, with five pistons to accomplish the regeneration steps of backwash, brine
4 draw/rinse, fast rinse, and brine refill, in addition to the service position.
- 5 3. The main control shall incorporate self-adjusting flow regulators to control the rate of flow and
6 prevent resin loss during backwash, regardless of the system pressure fluctuations between 30
7 and 120 psig.
- 8 4. Valves shall be controlled by integral electronic controls. Controls shall display status of each unit
9 with respect to service and regeneration. Controls for multi-tank systems shall be capable of
10 operating units simultaneously, alternating unit service, or progressively bringing additional units
11 on and off line as needed to maintain flow rates and reduce risk of channeling.
- 12 5. Regeneration shall be initiated by volume programmed so units are unable to regenerate
13 simultaneously.
- 14 6. The unit shall be supplied so that the valve will allow automatic bypass of untreated water during
15 regeneration. The bypass shall be integral to the main control.
- 16 7. All control mechanisms shall be enclosed in a UL listed NEMA 3 enclosure. A fully integrated,
17 programmable, microprocessor-driven electronic controller shall be provided to automatically
18 cycle the main control through the regeneration sequence.
- 19 8. Each controller shall be provided with dry contacts that will be able to send alarms to the building
20 automation system.
- 21 9. Electrical Requirements: Each valve shall be prewired with a plug and cord and an inline breaker
22 to plug into a standard receptacle or wired to a common control panel so a single electrical
23 connection can be provided. 120 volt-single phase. Electric power shall not be needed for manual
24 regeneration. Inlet hydraulic pressure shall be required.
- 25 K. Extra Stock:
- 26 1. Furnish extra materials as listed below that match products installed and that are packaged and
27 labeled for storage.
- 28 a. Provide 200 lbs. additional salt in the same form as the original load. Salt shall be
29 delivered and stored on pallet(s). Locate the pallet(s) per the Owner's direction.
- 30 b. Provide one additional gasket for each handhole and manway.
- 31 L. Warranty:
- 32 1. Provide a standard one-year warranty on the entire unit from the date of final acceptance.
- 33 2. Provide a standard two-year warranty on the control valve internal parts, the brine valve and
34 associated parts, and the salt storage container internal components.
- 35 3. Provide a standard five-year warranty on the control valve body, fiberglass wound container(s) (if
36 applicable), salt storage container(s) (if applicable), and epoxy lined steel conditioner tank(s) (if
37 applicable).
- 38 M. Acceptable Manufacturers: Capitol Water Softener

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

3 A. Install all items in accordance with manufacturer's instructions.

4 **3.2 WATER HEATER INSTALLATION**

5 A. Install water heaters on concrete bases. Coordinate sizes and locations of concrete bases. Refer to Section
6 22 05 29.

7 B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced
8 standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices
9 needing service are accessible.

10 C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves
11 with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge
12 by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.

13 D. Install gas water heaters according to NFPA 54.

14 **3.3 WATER SOFTENER INSTALLATION**

15 A. Verify connection sizes and piping type with cold water and soft cold water piping. Provide dielectric
16 connection between dissimilar metals. Pressure gauges are required at hard water inlet and soft water
17 outlet of each softener.

18 B. Provide system start-up and subsequent service, with stocking of spare parts by authorized dealer or factory
19 trained personnel.

20 C. Provide complete instructions covering installation and operation of the softening system in booklet form.
21 All components shall be easily identified, in exploded views, by individual part number.

22 D. Provide 1 hour of instruction and orientation to the Owner's maintenance staff by factory trained
23 personnel. System walk-through, including programming of any system controllers shall be included in
24 training.

25 **END OF SECTION**

**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 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.
 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.

- 1 6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons,
2 space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
- 3 7. Refer to Plumbing Material List for fixture mounting heights.
- 4 8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with
5 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black
6 lettering on a yellow background.
- 7 B. Wall-Mounted Fixture Requirements:
- 8 1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and
9 suitable for the space available and configuration of fixtures. All carriers shall extend to the floor
10 and be anchored to the slab.
- 11 C. Floor-Mounted Fixture Requirements:
- 12 1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall
13 be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration
14 to the floor below.
- 15 D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:
- 16 1. All traps exposed under fixtures or inside accessible cabinets shall be chrome plated brass.
- 17 2. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome
18 plated.
- 19 3. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor
20 the piping to the wall.
- 21 4. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or
22 other water outlet shall be chrome plated.
- 23 E. ADA Lavatory Requirements:
- 24 1. All handicapped accessible lavatory traps, piping and angle stops shall be installed with an
25 insulating kit specially manufactured for this installation. Armaflex with duct tape is not
26 acceptable.
- 27 F. ADA Water Closet Requirements:
- 28 1. Handicapped accessible water closet flush valve handles shall face the center of the stall.
- 29 2. Coordinate flush valves in handicap accessible locations with grab bars installed by the General
30 Contractor. Make modifications required to flush valve after review by Architect/Engineer.
- 31 **3.2 ADJUSTING AND CLEANING**
- 32 A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- 33 B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

- 1 6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or
2 modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although
3 other voltages may be encountered.
- 4 B. General:
- 5 1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's
6 responsibilities related to electrical work required for items such as temperature controls,
7 mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for
8 much of the equipment cannot be determined until the systems have been selected and submittals
9 reviewed. Therefore, the electrical drawings show only known wiring related to such items. All
10 wiring not shown on the electrical drawings, but required for mechanical systems, is the
11 responsibility of the Mechanical Contractor.
- 12 2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the
13 Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The
14 Mechanical Contractor shall provide complete wiring diagrams and supervision to the Electrical
15 Contractor and designate the terminal numbers for correct wiring.
- 16 3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical
17 Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical
18 Contractor unless noted otherwise.
- 19 C. Mechanical Contractor's Responsibility:
- 20 1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor,
21 for example:
- 22 a. Water Source Heat Pumps
23 b. VRF Systems
- 24 2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control
25 Contractor is a Subcontractor to the Mechanical Contractor.
- 26 3. Temperature Control Subcontractor's Responsibility:
- 27 a. Wiring of all devices needed to make the Temperature Control System functional.
- 28 b. Verifying any control wiring on the electrical drawings as being by the Electrical
29 Contractor. All wiring required for the Control System, but not shown on the electrical
30 drawings, is the responsibility of the Temperature Control Subcontractor.
- 31 c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical
32 Contractor, where wiring of the equipment is by the Electrical Contractor.
- 33 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
34 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
35 determine a viable layout.
- 36 D. Electrical Contractor's Responsibility:
- 37 1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical
38 Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or
39 Specifications.
- 40 2. Installs and wires all remote control devices furnished by the Mechanical Contractor or
41 Temperature Control Subcontractor when so noted on the Electrical Drawings.

- 1 3. Provides motor control and temperature control wiring, where so noted on the drawings.
- 2 4. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon
3 actuation of the Fire Alarm System as indicated and specified in Division 28.
- 4 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
5 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
6 determine a viable layout.

7 **1.4 COORDINATION DRAWINGS**

8 A. Definitions:

- 9 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the
10 sizes and locations, including elevations, of system components and required access areas to ensure
11 that no two objects will occupy the same space.
- 12 a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork,
13 fire protection systems, plumbing piping, hydronic piping, and any item that may impact
14 coordination with other disciplines.
- 15 b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5”
16 and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting,
17 ceiling-mounted devices, and any item that may impact coordination with other
18 disciplines.
- 19 c. Technology trades shall include, but are not limited to, technology equipment, racks,
20 conduit 1.5” and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway,
21 ceiling-mounted devices, and any item that may impact coordination with other
22 disciplines.
- 23 d. Maintenance clearances and code-required dedicated space shall be included.
- 24 e. The coordination drawings shall include all underground, underfloor, in-floor, in chase,
25 and vertical trade items.
- 26 2. The contractors shall use the coordination process to identify the proper sequence of installation
27 of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated
28 end result, and to provide adequate access for service and maintenance.

29 B. Participation:

- 30 1. The contractors and subcontractors responsible for work defined above shall participate in the
31 coordination drawing process.
- 32 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a
33 complete set of composite electronic CAD coordination drawings that include all applicable trades,
34 and for coordinating the activities related to this process. The Coordinating Contractor for this
35 project shall be the HVAC Contractor.
- 36 a. The Coordinating Contractor shall utilize personnel familiar with requirements of this
37 project and skilled as draftspersons/CAD operators, competent to prepare the required
38 coordination drawings.
- 39 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by
40 other trades. IMEG will provide electronic file copies of ventilation drawings for contractor’s use if
41 the contractor signs and returns an “Electronic File Transfer” waiver provided by IMEG. IMEG will
42 not consider blatant reproductions of original file copies an acceptable alternative for coordination
43 drawings.

- 1 C. General:
- 2 1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E
3 will only review identified conflicts and give an opinion, but will not perform as a coordinator.
- 4 2. A plotted set of coordination drawings shall be available at the project site.
- 5 3. Coordination drawings are not shop drawings and shall not be submitted as such.
- 6 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for
7 each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material,
8 and labor to allow for adjustments in routing of utilities made necessary by the coordination process
9 and to provide a complete and functional system.
- 10 5. The contractors will not be allowed additional costs or time extensions due to participation in the
11 coordination process.
- 12 6. The contractors will not be allowed additional costs or time extensions for additional fittings,
13 reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the
14 drawings and determined necessary through the coordination process.
- 15 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts
16 or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
- 17 8. Changes to the contract documents that are necessary for systems installation and coordination
18 shall be brought to the attention of the A/E.
- 19 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated
20 on the drawings.
- 21 a. Access to mechanical, electrical, technology, and other items located above the ceiling
22 shall be through accessible lay-in ceiling tile areas.
- 23 b. Potential layout changes shall be made to avoid additional access panels.
- 24 c. Additional access panels shall not be allowed without written approval from the A/E at
25 the coordination drawing stage.
- 26 d. Providing additional access panels shall be considered after other alternatives are
27 reviewed and discarded by the A/E and the Owner's Representative.
- 28 e. When additional access panels are required, they shall be provided without additional
29 cost to the Owner.
- 30 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors
31 prior to installing any of the components.
- 32 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the
33 contractor or subcontractor who did not properly identify their work requirements, or installed
34 their work without proper coordination.
- 35 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1 **1.5 QUALITY ASSURANCE**

2 A. Contractor's Responsibility Prior to Submitting Pricing Data:

3 1. The Contractor is responsible for constructing complete and operating systems. The Contractor
4 acknowledges and understands that the Contract Documents are a two-dimensional representation
5 of a three-dimensional object, subject to human interpretation. This representation may include
6 imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field
7 coordination items. Such deficiencies can be corrected when identified prior to ordering material
8 and starting installation. The Contractor agrees to carefully study and compare the individual
9 Contract Documents and report at once in writing to the Design Team any deficiencies the
10 Contractor may discover. The Contractor further agrees to require each subcontractor to likewise
11 study the documents and report at once any deficiencies discovered.

12 2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding
13 any subcontracts, ordering material, or starting any work with the Contractor's own employees.
14 Any work performed prior to receipt of instructions from the Design Team will be done at the
15 Contractor's risk.

16 B. Qualifications:

17 1. Only products of reputable manufacturers are acceptable.

18 2. All Contractors and subcontractors shall employ only workers skilled in their trades.

19 C. Compliance with Codes, Laws, Ordinances:

20 1. Conform to all requirements of the City of Madison, Wisconsin Codes, Laws, Ordinances and other
21 regulations having jurisdiction.

22 2. Conform to all State Codes.

23 3. If there is a discrepancy between the codes and regulations and these specifications, the
24 Architect/Engineer shall determine the method or equipment used.

25 4. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do
26 not comply with the codes or regulations, he shall inform the Architect/Engineer in writing,
27 requesting a clarification. If there is insufficient time for this procedure, he shall submit with his
28 proposal a separate price to make the system comply with the codes and regulations.

29 5. All changes to the system made after letting of the contract, to comply with codes or requirements
30 of Inspectors, shall be made by the Contractor without cost to the Owner.

31 6. If there is a discrepancy between manufacturer's recommendations and these specifications, the
32 manufacturer's recommendations shall govern.

33 7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards
34 and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is
35 responsible for providing this guarding if it is not provided with the equipment supplied.

36 D. Permits, Fees, Taxes, Inspections:

37 1. Procure all applicable permits and licenses.

38 2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where
39 the work is done, or as required by any duly constituted public authority.

40 3. Refer to 00 31 46 for additional details and requirements.

- 1 4. Where applicable, all fixtures, equipment and materials shall be approved or listed by Underwriter's
2 Laboratories, Inc.
- 3 E. Examination of Drawings:
- 4 1. The drawings for the mechanical work are completely diagrammatic, intended to convey the scope
5 of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and
6 the approximate sizes of equipment.
- 7 2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing
8 of pipes and ducts to best fit the layout of the job.
- 9 3. Scaling of the drawings is not sufficient or accurate for determining these locations.
- 10 4. Where job conditions require reasonable changes in indicated arrangements and locations, such
11 changes shall be made by the Contractor at no additional cost to the Owner.
- 12 5. Because of the scale of the drawings, certain basic items, such as fittings, boxes, valves, unions, etc.,
13 may not be shown, but where required by other sections of the specifications or required for proper
14 installation of the work, such items shall be furnished and installed.
- 15 6. If an item is either on the drawings or in the specifications, it shall be included in this contract.
- 16 7. Determination of quantities of material and equipment required shall be made by the Contractor
17 from the documents. Where discrepancies arise between drawings, schedules and/or
18 specifications, the greater number shall govern.
- 19 8. Where used in mechanical documents, the word "furnish" shall mean supply for use, the word
20 "install" shall mean connect complete and ready for operation, and the word "provide" shall mean
21 to supply for use and connect complete and ready for operation.
- 22 a. Any item listed as furnished shall also be installed, unless otherwise noted.
- 23 b. Any item listed as installed shall also be furnished, unless otherwise noted.
- 24 F. Field Measurements:
- 25 1. Verify all pertinent dimensions at the job site before ordering any materials or fabricating any
26 supports, pipes or ducts.
- 27 G. Electronic Media/Files:
- 28 1. Construction drawings for this project have been prepared utilizing Revit.
- 29 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or
30 copies of the specifications. Specifications will be provided in PDF format.
- 31 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic
32 File Transmittal" form provided by IMEG.
- 33 4. If the information requested includes floor plans prepared by others, the Contractor will be
34 responsible for obtaining approval from the appropriate Design Professional for use of that part of
35 the document.
- 36 5. The electronic contract documents can be used for preparation of shop drawings and as-built
37 drawings only. The information may not be used in whole or in part for any other project.

- 1 6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout
2 drawings or coordination drawings.
- 3 7. The use of these electronic files by the Contractor does not relieve them from their responsibility
4 for coordination of work with other trades and verification of space available for the installation.
- 5 8. The information is provided to expedite the project and assist the Contractor with no guarantee by
6 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility
7 or liability for the Contractor's use of these documents.

8 **1.6 SUBMITTALS**

9 A. Submittals shall be required for the following items, and for additional items where required elsewhere in the
10 specifications or on the drawings.

11 1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
23 05 00	Owner Training Agenda
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 36 00	Terminal Air Boxes
23 37 00	Grilles, Registers, and Diffusers
23 37 00	Louvers
23 72 00	Energy Recovery Devices
23 73 13	Indoor Modular Air Handling Units
23 81 45	Variable Refrigerant Volume Heat Pumps
23 81 46	Packaged Water Source Heat Pumps
23 82 00	Terminal Heat Transfer Equipment

12 B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

13 1. Transmittal: Each transmittal shall include the following:

- 14 a. Date
- 15 b. Project title and number
- 16 c. Contractor's name and address
- 17 d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 18 e. Description of items submitted and relevant specification number
- 19 f. Notations of deviations from the contract documents
- 20 g. Other pertinent data

21 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- 22 a. Date
- 23 b. Project title and number
- 24 c. Architect/Engineer
- 25 d. Contractor and subcontractors' names and addresses
- 26 e. Supplier and manufacturer's names and addresses
- 27 f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 28 g. Description of item submitted (using project nomenclature) and relevant specification
29 number
- 30 h. Notations of deviations from the contract documents

- 1 i. Other pertinent data
2 j. Provide space for Contractor's review stamps
- 3 3. Composition:
- 4 a. Submittals shall be submitted using specification sections and the project nomenclature
5 for each item.
- 6 b. Individual submittal packages shall be prepared for items in each specification section. All
7 items within a single specification section shall be packaged together where possible. An
8 individual submittal may contain items from multiple specifications sections if the items
9 are intimately linked (e.g., pumps and motors).
- 10 c. All sets shall contain an index of the items enclosed with a general topic description on
11 the cover.
- 12 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings;
13 manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures;
14 performance and test data; wiring and control diagrams; dimensions; shipping and operating
15 weights; shipping splits; service clearances; and all other drawings and descriptive data of materials
16 of construction as may be required to show that the materials, equipment or systems and the
17 location thereof conform to the requirements of the contract documents.
- 18 5. Contractor's Approval Stamp:
- 19 a. The Contractor shall thoroughly review and approve all shop drawings before submitting
20 them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal
21 certifying it has been reviewed.
- 22 b. Unstamped submittals will be rejected.
- 23 c. The Contractor's review shall include, but not be limited to, verification of the following:
- 24 1) Only approved manufacturers are used.
25 2) Addenda items have been incorporated.
26 3) Catalog numbers and options match those specified.
27 4) Performance data matches that specified.
28 5) Electrical characteristics and loads match those specified.
29 6) Equipment connection locations, sizes, capacities, etc. have been coordinated
30 with other affected trades.
31 7) Dimensions and service clearances are suitable for the intended location.
32 8) Equipment dimensions are coordinated with support steel, housekeeping pads,
33 openings, etc.
34 9) Constructability issues are resolved (e.g., weights and dimensions are suitable
35 for getting the item into the building and into place, sinks fit into countertops,
36 etc.).
- 37 d. The Contractor shall review, stamp and approve all subcontractors' submittals as
38 described above.
- 39 e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the**
40 **Contractor's review of all material and a complete understanding of exactly what is to**
41 **be furnished. Contractor shall clearly mark all deviations from the contract documents**
42 **on all submittals. If deviations are not marked by the Contractor, then the item shall be**
43 **required to meet all drawing and specification requirements.**

- 1 6. Submittal Identification and Markings:
- 2 a. The Contractor shall clearly mark each item with the same nomenclature applied on the
- 3 drawings or in the specifications.
- 4 b. The Contractor shall clearly indicate the size, finish, material, etc.
- 5 c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall
- 6 clearly indicate exactly which item and which data is intended.
- 7 d. All marks and identifications on the submittals shall be unambiguous.
- 8 7. Schedule submittals to expedite the project. Coordinate submission of related items.
- 9 8. Identify variations from the contract documents and product or system limitations that may be
- 10 detrimental to the successful performance of the completed work.
- 11 9. Reproduction of contract documents alone is not acceptable for submittals.
- 12 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with
- 13 prior approval from the Architect/Engineer.
- 14 11. Submittals not required by the contract documents may be returned without review.
- 15 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for
- 16 each product. If the first submittal is incomplete or does not comply with the drawings and/or
- 17 specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to
- 18 recheck and handle the additional shop drawing submittals.
- 19 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any
- 20 equipment for manufacture or shipment.
- 21 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in
- 22 submittals is not relieved by the Architect/Engineer's approval.
- 23 C. Electronic Submittal Procedures:
- 24 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer,
- 25 unless a web-based submittal program is used.
- 26 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
- 27 3. Format: Electronic submittals shall be in PDF format only. Submittals that are not legible will be
- 28 rejected. Do not set any permission restrictions on files; protected, locked, or secured documents
- 29 will be rejected.
- 30 4. File Names: Electronic submittal file names shall include the relevant specification section number
- 31 followed by a description of the item submitted, as follows. Where possible, include the transmittal
- 32 as the first page of the PDF instead of using multiple electronic files.
- 33 a. Submittal file name: 23 XX XX.description.YYYYMMDD
- 34 b. Transmittal file name: 23 XX XX.description.YYYYMMDD
- 35 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted
- 36 via a pre-approved method.

1 **1.7 EQUIPMENT SUPPLIERS' INSPECTION**

2 A. The following equipment shall not be placed in operation until a competent installation and service
3 representative of the manufacturer has inspected the installation and certified that the equipment is properly
4 installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the
5 equipment is ready for operation:

- 6 1. Water Source Heat Pumps
- 7 2. VRF Systems
- 8 3. Air Handling Units
- 9 4. Energy Recovery Units

10 B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase
11 of equipment installation and/or connection is in accordance with the manufacturer's instructions.

12 C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and
13 Maintenance Manuals.

14 **1.8 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

15 A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to
16 prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any
17 materials that become wet or that are suspected of becoming contaminated with mold or other organisms.

18 B. Keep all bearings properly lubricated and all belts properly tensioned and aligned.

19 C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the
20 Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment,
21 he/she shall contract with a qualified lifting and rigging service that has similar documented experience.
22 Follow all equipment lifting and support guidelines for handling and moving.

23 D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site
24 prior to bid for path locations and any required building modifications to allow movement of equipment.
25 Contractor shall coordinate his/her work with other trades.

26 **1.9 WARRANTY**

27 A. Refer to Division 01 specification for requirements.

28 **1.10 MATERIAL SUBSTITUTION**

29 A. Refer to Division 01 specification for requirements.

30 **1.11 LEED REQUIREMENTS**

31 A. This project is pursuing a LEED Silver certification in accordance with USGBC LEED Rating System for New
32 Construction Version 2009. The Contractor shall provide all services and documentation necessary to achieve
33 this rating.

34 B. Refer to Division 01 specification for requirements.

35 **1.12 PROJECT COMMISSIONING**

36 A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00, and provide
37 all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3
38 Enhanced Commissioning.

1 **PART 2 - PRODUCTS**

2 NOT APPLICABLE

3 **PART 3 - EXECUTION**

4 **3.1 JOBSITE SAFETY**

5 A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or
6 his or her employee and subconsultants at a construction site, shall relieve the Contractor and other entity of
7 their obligations, duties and responsibilities including, but not limited to, construction means, methods,
8 sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of
9 the work of construction in accordance with the contract documents and any health or safety precautions
10 required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to
11 exercise any control over any construction contractor or other entity or their employees in connection with
12 their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The
13 Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made
14 additional insureds under the Contractor's general liability insurance policy.

15 **3.2 OPERATION AND MAINTENANCE MANUALS**

16 A. Refer to Division 01 specification for requirements.

17 **3.3 INSTRUCTING THE OWNER'S REPRESENTATIVES**

18 A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all
19 systems installed under this contract per specification 01 79 00.

20 B. The instructions shall include:

- 21 1. Explanation of all system flow diagrams.
22 2. Explanation of all air handling systems.
23 3. Temperature control system operation including calibration, adjustment and proper operating
24 conditions of all sensors.
25 4. Maintenance of equipment.
26 5. Start-up procedures for all major equipment.
27 6. Explanation of seasonal system changes.
28 7. Description of emergency system operation.

29 C. Minimum hours of instruction for each item shall be:

- 30 1. Geothermal Water System - 2 hours.
31 2. VRF System - 8 hours.
32 3. Chemical Treatment System - As defined in Section 23 25 00.
33 4. Air Handling System(s) - 2 hours.
34 5. Temperature Controls - As defined in Section 23 09 00.

35 **3.4 SYSTEM COMMISSIONING**

36 A. Refer to specification 01 91 00 for additional requirements.

37 B. The mechanical systems shall be complete and operating. System start-up, testing, balancing, and
38 satisfactory system performance is the responsibility of the Contractor. This includes calibration and
39 adjustments of all controls, noise level adjustments and final comfort adjustments as required.

40 C. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction
41 materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60% RH.

- 1 D. Contractor shall adjust the mechanical systems and controls at season changes during the one year warranty
2 period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- 3 E. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks,
4 safety shutdowns, controls, and alarms.
- 5 F. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all
6 systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting,
7 assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship
8 problems, equipment substitution issues or unsatisfactory system performance, including call backs during
9 the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and
10 materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the
11 services are requested. The Contractor shall pay the Owner for services required that are product, installation
12 or workmanship related. Payment is due within 30 days after services are rendered.

13 **3.5 RECORD DOCUMENTS**

- 14 A. The following paragraph supplements Division 1 requirements:
- 15 Contractor shall maintain at the job site a separate and complete set of mechanical drawings and
16 specifications on which he shall clearly and permanently mark in complete detail all changes made to the
17 mechanical systems.
- 18 B. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior;
19 including locations of coils, dampers, other control devices, filters, and other units requiring periodic
20 maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and
21 locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches
22 of piping systems, with valves and control devices located and numbered, concealed unions located, and with
23 items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change
24 Orders; concealed control system devices.
- 25 C. Refer to Section 23 09 00 for additional requirements for Temperature Control documents.
- 26 D. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials
27 used.
- 28 E. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at
29 any normal work time.
- 30 F. Upon completing the job, and before final payment is made, give the marked-up drawings to the
31 Architect/Engineer. Refer to 01 78 39 for additional requirements.

32 **3.6 ADJUST AND CLEAN**

- 33 A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all
34 foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- 35 B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or
36 water damage.
- 37 C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

38 **3.7 CONSTRUCTION WASTE MANAGEMENT**

- 39 A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements
40 outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as
41 referenced in these specifications).

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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.

16 **END OF SECTION**

1 READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

2 In order to prevent the final job observation from occurring too early, we require that the Contractor review the completion
3 status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following
4 is a typical list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

- 5 1. All air handling units operating and balanced.
- 6 2. All fans shall be operating and balanced.
- 7 3. All pumps, boilers operating and balanced.
- 8 4. All miscellaneous mechanical systems (unit heaters, fan coil units, cabinet heaters, etc.) operating.
- 9 5. All temperature control systems operating, programmed and calibrated.
- 10 6. Pipe insulation complete, pipes labeled and valves tagged.
- 11 7. Fire damper and fire/smoke damper access doors labeled in accordance with specifications.

12 Accepted by:

13 Prime Contractor _____

14 By _____ Date _____

15 Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign
16 this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

17 It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and
18 observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time
19 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

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Through-Penetration Firestopping.

6 **1.2 QUALITY ASSURANCE**

- 7 A. Manufacturer: Company specializing in manufacturing products specified in this Section.
- 8 B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for
9 installation.

10 **1.3 DELIVERY, STORAGE, AND HANDLING**

- 11 A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect
12 for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or
13 other causes. Follow manufacturer's instructions for storage.
- 14 B. Install material prior to expiration of product shelf life.

15 **1.4 PERFORMANCE REQUIREMENTS**

- 16 A. General: For penetrations through the following fire-resistance-rated constructions, including both empty
17 openings and openings containing penetrating items, provide through-penetration firestop systems that are
18 produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke
19 and other gases, and maintain original fire-resistance rating of construction penetrated.

- 20 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
- 21 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling
22 membranes of roof/ceiling assemblies.

- 23 B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL
24 1479:

- 25 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not
26 less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- 27 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with
28 T-ratings indicated, as well as F-ratings:

- 29 a. Floor penetrations located outside wall cavities.
- 30 b. Floor penetrations located outside fire-resistance-rated shaft enclosures.

- 31 C. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide
32 products that, after curing, do not deteriorate when exposed to these conditions both during and after
33 construction.

- 34 D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-
35 developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

- 36 E. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-
37 developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

- 1 F. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants
2 used on the interior of the building must comply with the following requirements:
- 3 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management
4 District (SCAQMD) Rule #1168.
- 5 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36
6 requirements in effect on October 19, 2000.

7 **1.5 WARRANTY**

- 8 A. Provide one year warranty on parts and labor.
- 9 B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion
10 resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability,
11 or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of
12 the material.

13 **PART 2 - PRODUCTS**

14 **2.1 MANUFACTURERS**

- 15 A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems
16 indicated for each application that are produced by one of the following manufacturers. All firestopping
17 systems installed shall be provided by a single manufacturer.
- 18 1. 3M; Fire Protection Produces Division.
19 2. Hilti, Inc.
20 3. RectorSeal Corporation, Metacaulk.
21 4. Tremco; Sealant/Weatherproofing Division.
22 5. Johns-Manville.
23 6. Specified Technologies Inc. (S.T.I.)
24 7. Spec Seal Firestop Products
25 8. AD Firebarrier Protection Systems

26 **2.2 THROUGH PENETRATION FIRESTOP SYSTEMS**

- 27 A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping
28 equal to time rating of construction being penetrated.
- 29 B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require
30 hazardous waste removal.
- 31 C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and
32 contraction.
- 33 D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- 34 E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor
35 loading or traffic.
- 36 F. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- 37 G. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through
38 all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock
39 Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size
40 and material and shall fall within the range of numbers listed:

- 1 1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
2 F Rating = Floor/Wall Rating
3 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
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

- 4 2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
5 F Rating = Wall Rating
6 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

- 7 3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
8 F Rating = Wall/Floor Rating
9 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

10 *Alternate method of firestopping is patching opening to match original rated construction.

- 11 H. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the
12 firestopping manufacturer.

- 1 I. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance
2 Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the
3 Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

4 **PART 3 - EXECUTION**

5 **3.1 EXAMINATION**

6 A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean
7 and repair surfaces as required. Remove laitance and form-release agents from concrete.

8 B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping
9 systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing
10 firestopping systems.

11 C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey
12 system substrate criteria.

13 D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer.
14 Confine primer to area of bond.

15 **3.2 INSTALLATION**

16 A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items.
17 Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall
18 consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate
19 method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped
20 immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock
21 Hersey listed firestopping system is installed.

22 B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock
23 Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

24 C. Install dams as required to properly contain firestopping materials within openings and as required to achieve
25 required fire resistance rating. Remove combustible damming after appropriate curing.

26 **3.3 CLEANING AND PROTECTING**

27 A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials
28 that are approved in writing by through-penetration firestop system manufacturers and that do not cause
29 damage.

30 B. Provide final protection and maintain conditions during and after installation that ensure that through-
31 penetration firestop systems are without damage or deterioration at time of Substantial Completion. If,
32 despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-
33 penetration firestop systems immediately and install new materials to produce systems complying with
34 specified requirements.

35 **3.4 IDENTIFICATION**

36 A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system
37 supplier and contain the following information in a contrasting color:

- 38 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building
39 Management of Any Damage."

**SECTION 23 05 13
MOTORS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 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.

1.3 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.4 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 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), totally enclosed fan-cooled type.
- F. Each contractor shall set all motors furnished by them.
- G. All motors shall have a minimum service factor of 1.15.
- H. 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.
- I. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.
- J. Aluminum end housings are not permitted on motors 15 HP or larger.

- 1 K. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2
 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide
 3 bases shall conform to NEMA standards.
- 4 L. Motors for fans and pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated
 5 motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431.
 6 These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-
 7 driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed. Motors shall
 8 be single phase, 60 hertz.

9 **2.2 PREMIUM EFFICIENCY MOTORS (INCLUDING MOST 3-PHASE GENERAL PURPOSE MOTORS)**

- 10 A. All motors, unless exempted by EAct legislation that became federal law on December 19, 2010, shall
 11 comply with the efficiencies listed in that standard, which are reprinted below. These match the 2010
 12 NEMA premium efficiency ratings. All ratings listed are nominal full load efficiencies, verified in accordance
 13 with IEEE Standard 112, Test Method B. Average expected (not guaranteed minimum) power factors shall
 14 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

- 15 B. Motor nameplate shall be noted with the above ratings.

16 **2.3 MOTORS ON VARIABLE FREQUENCY DRIVES**

- 17 A. All motors driven by VFDs shall be premium efficiency type.
- 18 B. Motors shall be designed for use with VFDs in variable torque applications with 1.15 service factor. Motors
 19 shall not be equipped with auxiliary blowers.
- 20 C. Motors driven by VFDs shall have Class F or H insulation and be designated by the motor manufacturer to
 21 be suitable for inverter duty service in accordance with NEMA MG 1 Section IV, "Performance Standards
 22 Applying to All Machines," Part 31 "Definite-Purpose Inverter-Fed Polyphase Motors.
- 23 A. All 208 volt motors controlled by VFDs shall be equipped with an alternate discharge path, such as a shaft
 24 grounding ring or grounding brush, to divert adverse shaft currents from the motor bearings on the drive
 25 end of the motor shaft. Motor shafts 2" and larger require shaft grounding on the drive end and the non-
 26 drive end. This Contractor shall ensure (via field observation and measurement) that the shaft is effectively
 27 grounded upon startup.
- 28 1. Providing grounding rings internal to the motor housing is an acceptable solution, provided the
 29 motor is affixed with a label clearly indicating the presence of a grounding assembly. The
 30 grounding ring shall be listed for 40,000 hours of motor service and shall be accessible via the
 31 drive endplate.

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SECTION 23 05 15
VARIABLE FREQUENCY DRIVES

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Variable frequency drives

6 **1.2 RELATED SECTIONS AND WORK**

- 7 A. Refer to the Variable Frequency Drive Schedule for rating and configuration.
8 B. Refer to 23 09 00 for additional requirements.

9 **1.3 SUBMITTALS**

- 10 A. Submit shop drawings and product data under provisions of Section 23 05 00.
11 B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown;
12 conduit entrance locations and requirements; and nameplate legends.
13 C. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and
14 overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
15 D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by
16 Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling,
17 protection, examination, preparation, installation, and starting of Product.
18 E. Provide harmonic distortion analysis of total service to prove variable frequency drives proposed do not
19 exceed the latest version of IEEE 519 voltage and current distortion limits as shown in Table 10.2 and 10.3 at
20 the point of common coupling (PCC). The PCC shall be defined as the consumer-utility interface or primary
21 side of the main distribution transformer.

22 **1.4 EXTRA MATERIAL**

- 23 A. Furnish under provisions of Section 23 05 00.
24 B. Provide two of each air filter.
25 C. Provide three of each fuse size and type.

26 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 27 A. Deliver, store, protect and handle products to site under provisions of Section 23 05 00.
28 B. Accept controllers on site in original packing. Inspect for damage.
29 C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy
30 plastic cover to protect units from dirt, water, construction debris, and traffic.
31 D. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose.
32 Handle carefully to avoid damage.

33 **1.6 OPERATION AND MAINTENANCE DATA**

- 34 A. Submit operation and maintenance data under provisions of Section 23 05 00.

- 1 B. Maintenance Data: Include spare parts data listing, source and current prices of replacement parts and
2 supplies, and recommended maintenance procedures and intervals.
- 3 C. Operation Data: Include instructions for starting and operating controllers, and describe operating limits
4 that may result in hazardous or unsafe conditions.
- 5 D. Shop Drawings: For each VFD.
- 6 1. Include dimensioned plans, elevations, sections, and details, including required clearances and
7 service space around equipment. Show tabulations of installed devices, equipment features, and
8 ratings. Include the following:
- 9 a. Each installed unit's type and details.
- 10 b. Nameplate legends.
- 11 c. Short-circuit current rating of integrated unit.
- 12 d. UL listing for series rating of overcurrent protective devices in combination controllers.
- 13 e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
- 14 2. Wiring Diagrams: Power, signal, and control wiring for VFDs. Provide schematic wiring diagram
15 for each type of VFD.

16 **PART 2 - PRODUCTS**

17 **2.1 ACCEPTABLE MANUFACTURERS: DANFOSS**

18 **2.2 DESCRIPTION**

- 19 A. Converts 60 Hertz input power at voltage specified to a variable AC frequency and voltage for controlling
20 the speed of AC squirrel cage motors. The controller shall be suitable for use with standard NEMA B squirrel
21 cage 1.15 service factor induction motors without requiring any modifications to the motor or the drive.
- 22 B. Controller shall have sufficient capacity to provide speed control of the motors shown or noted throughout
23 the specified environmental operating conditions.
- 24 C. Controller shall have the functional components listed below:
- 25 1. Door interlocked input circuit breaker/fused switch.
- 26 2. Input rectifier section to supply fixed DC bus voltage.
- 27 3. Smoothing reactor for DC bus.
- 28 4. DC bus capacitors.
- 29 5. Control transformer.
- 30 6. Separate terminal blocks for power and control wiring.
- 31 7. Terminal block for operator controls.
- 32 8. Sine weighted PWM generating inverter section.

33 **2.3 RATINGS**

- 34 A. Rated Input Voltage: Refer to mechanical equipment schedule for motor requirements.
- 35 B. Motor Nameplate (Drive Output) Voltage: Refer to Mechanical Schedules.
- 36 C. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

- 1 D. Operating Ambient: 0°C to 40°C.
- 2 E. Minimum Relative Humidity Range: 5% to 90% (non-condensing).
- 3 F. Minimum Elevation without Derating: 3300 feet.
- 4 G. Minimum Efficiency at Full Load: 96 percent.
- 5 H. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3
6 seconds or 180% for 0.5 seconds.
- 7 I. Starting Torque: 100 percent of rated torque or as indicated.
- 8 J. Speed Regulation: Plus or minus 1 percent with no motor derating.

9 **2.4 DESIGN**

- 10 A. Pulse Width Modulated (PWM) Variable Frequency Drives:
 - 11 1. Converter shall be of a diode bridge design with a sine-weighted PWM inverter section.
 - 12 2. Main semi-conductors in the inverter section of controller shall be IGBT transistors capable of a
13 carrier switching frequency of up to 8 kHz. If derating of the inverter is necessary to run at 8kHz,
14 then the unit's derated currents must equal or exceed the motor full load currents listed in NEC
15 Table 430-150.
 - 16 3. All controllers supplied with semi-conductors capable of switching at less than 8,000 Hertz shall be
17 supplied with a motor acoustic noise reduction filter.
 - 18 4. Pulse width modulated (PWM) drives shall be supplied with drive input line reactors with a
19 minimum impedance of 3%. Reactors shall be installed to filter entire drive input circuit.
 - 20 5. Pulse width modulated (PWM) drives shall be supplied with drive input harmonic filter to reduce
21 the total harmonic distortion to less than the IEEE519-1992 limits at the utility service entrance.
 - 22 6. Drives that are located beyond the manufacturer's recommended maximum distance from the
23 motor shall be provided with dV/dt (long lead) filters.
- 24 B. All drives shall have built-in diagnostic capability with status and fault indicators mounted on enclosure
25 door. Complete operating instructions for diagnostics shall be mounted inside of the enclosure door.
- 26 C. Drive shall restart after power loss and under-voltage fault. The minimum number of restart attempts
27 required shall be three, field adjustable.
- 28 D. The drive shall allow unlimited switching of the output without damage to the drive or motor.

29 **2.5 PRODUCT FEATURES**

- 30 A. Display: Provide integral digital display to indicate all protection faults and drive status (including
31 overcurrent, overvoltage, undervoltage, ground fault, overtemperature, phase loss, input power ON, output
32 voltage, output frequency, and output current.
- 33 B. Protection:
 - 34 1. Input transient protection by means of surge suppressors.
 - 35 2. Snubber networks to protect against malfunctions due to system transients,

- 1 3. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
- 2 4. Motor thermal overload relay(s) adjustable and capable of NEMA Class 20 motor protection and
- 3 sized per motor nameplate data. When multiple motors are connected to the VFD output, each
- 4 motor shall have a manual starter with properly sized overload protection.
- 5 5. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency
- 6 of the combination.
- 7 6. Instantaneous line-to-line and line-to-ground overcurrent trips on input and output.
- 8 7. Loss-of-phase protection.
- 9 8. Reverse-phase protection.
- 10 9. Short-circuit protection (fuses or circuit breaker).
- 11 10. Motor overtemperature fault.
- 12 C. Acceleration Rate Adjustment: 0.5 - 30 seconds.
- 13 D. Deceleration Rate Adjustment: 1 - 30 seconds.
- 14 E. Minimum Adjustment Range for the Lower Output Frequency shall be: 0 to 40 Hertz.
- 15 F. Minimum Adjustment Range for the Upper Output Frequency Range shall be: 40 to 90 Hertz.
- 16 G. Minimum Volts/Hertz Range: 3.7 to 8.6 volts/Hertz.
- 17 H. Provide MANUAL-OFF-AUTOMATIC selector switch and manual analog speed control mounted on the front
- 18 of the enclosure.
- 19 I. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic
- 20 mode.
- 21 J. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.
- 22 K. Provide adjustable skip frequencies on the drive output (minimum of three ranges).
- 23 L. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an
- 24 interruption, and before shutting down for manual reset or fault correction. Bidirectional autospeed search
- 25 shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed
- 26 in proper direction, without damage to controller, motor, or load.
- 27 M. Power-Interruption Protection: After a power interruption, it prevents the motor from re-energizing until
- 28 the motor has stopped.
- 29 N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum
- 30 torque to ensure high-starting torque and increased torque at slow speeds.
- 31 O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency
- 32 for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- 33 P. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
 - 34 1. Power on.
 - 35 2. Run.
 - 36 3. Overvoltage.

- 1 4. Line fault.
2 5. Overcurrent.
3 6. External fault.
- 4 Q. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control
5 potentiometer and elapsed time meter.
- 6 R. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door
7 and connected to indicate the following controller parameters:
- 8 1. Output frequency (Hz).
9 2. Motor speed (rpm).
10 3. Motor status (running, stop, fault).
11 4. Motor current (amperes).
12 5. Motor torque (percent).
13 6. Fault or alarming status (code).
14 7. PID feedback signal (percent).
15 8. DC-link voltage (VDC).
16 9. Set-point frequency (Hz).
17 10. Motor output voltage (V).
- 18 S. Control Signal Interface:
- 19 1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6
20 programmable digital inputs.
- 21 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from
22 the BMS or other control systems:
- 23 a. 0 to 10-V dc.
24 b. 0-20 or 4-20 mA.
25 c. Potentiometer using up/down digital inputs.
26 d. Fixed frequencies using digital inputs.
27 e. RS485.
28 f. Keypad display for local hand operation.
- 29 3. Output Signal Interface:
- 30 a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of
31 the following:
- 32 1) Output frequency (Hz).
33 2) Output current (load).
34 3) DC-link voltage (VDC).
35 4) Motor torque (percent).
36 5) Motor speed (rpm).
37 6) Set-point frequency (Hz).
- 38 4. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1A) for remote
39 indication of the following:
- 40 a. Motor running.
41 b. Set-point speed reached.
42 c. Fault and warning indication (overtemperature or overcurrent).
43 d. PID high- or low-speed limits reached.

- 1 T. Communications: Provide a communications card to interface VFD with Facility Management Control
2 System (FMCS). Coordinate interface requirements with the FMCS provided under Section 23 09 00.
3 Interface shall allow all parameter settings of VFD to be programmed via FMCS control and displayed on
4 FMCS operator workstation. Provide capability for VFD to retain these settings within the nonvolatile
5 memory.
- 6 U. Three-Contactor Manual Bypass:
- 7 1. Provide contactors, motor running overload protection, under-voltage and loss of phase
8 protection, and short circuit protection for full voltage, non-reversing operation of the motor.
9 Include isolation switch or third contactor to allow maintenance of inverter during bypass
10 operation.
- 11 2. All bypass circuitry shall be located within the same enclosure as the variable frequency drive.
- 12 3. All fire alarm and/or smoke control interconnections (e.g., air handling unit shutdown) shall apply
13 regardless of whether control is through VFD or bypass.
- 14 4. Provide a Drive-Bypass Selector Switch.
- 15 5. Provide nameplate with instructions for switching from drive to bypass and from bypass to drive.
16 Provide instructions for isolating VFD for maintenance.
- 17 V. Control:
- 18 1. With the "Manual-Off-Auto" switch in the "Manual" position and, if applicable, the "Drive-Bypass"
19 in the "Drive" position, the drive shall be controlled by the manual speed potentiometer on the
20 drive door.
- 21 2. With the "Manual-Off-Auto" switch in the "Auto" position and, if applicable, the "Drive-Bypass" in
22 the "Drive" position, the drive shall be controlled by the input signal from an external source.
- 23 3. If applicable, with the "Drive-Bypass" in the "Bypass" position, regardless the position of the
24 "Manual-Off-Auto" switch, the motor shall be connected across the lines and shall be run at full
25 speed.
- 26 4. With the "Manual-Off-Auto" switch in the "Off" position, if applicable, the drive run circuit shall be
27 open and the VFD shall not operate.
- 28 5. If applicable, signal from the fire alarm control panel shall shut down VFD and bypass.
- 29 6. All disconnect switches between VFD and motor(s) shall include an auxiliary contact interlock
30 wired to the VFD fault trip input to shut down the drive upon opening of the disconnect main
31 contacts.
- 32 **2.6 ACCESSORIES**
- 33 A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- 34 B. All VFD supplied for fans shall have dynamic or DC injection braking capability to provide a means of rapid
35 deceleration of the AC motor in not more than one (1) minute. Adjust controls to stop the motor within 30
36 seconds.
- 37 C. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- 38 D. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp
39 arranged so padlock can be used to lock push button in depressed position with control circuit open.

- 1 E. Control Relays: Auxiliary and adjustable time-delay relays.
- 2 F. Standard Displays:
- 3 1. Output frequency (Hz).
- 4 2. Set-point frequency (Hz).
- 5 3. Motor current (amperes).
- 6 4. DC-link voltage (VDC).
- 7 5. Motor torque (percent).
- 8 6. Motor speed (rpm).
- 9 7. Motor output voltage (V).
- 10 G. Historical Logging Information and Displays:
- 11 1. Real-time clock with current time and date.
- 12 2. Running log of total power versus time.
- 13 3. Total run time.
- 14 4. Fault log, maintaining last four faults with time and date stamp for each.
- 15 H. Fabrication:
- 16 1. Enclosure: NEMA 250, Type 1.
- 17 2. Finish: Manufacturer's standard enamel.
- 18 **PART 3 - EXECUTION**
- 19 **3.1 FACTORY TESTING**
- 20 A. The VFD manufacturer shall provide certification that heat test has been completed.
- 21 B. The Electrical Contractor shall have a factory service engineer present for the start-up, field calibration, and
- 22 check-out of each VFD installed. Factory service engineer shall be required to return to the site for
- 23 recalibration or set-up should unit not function as specified during system commissioning. All costs shall be
- 24 a part of This Contract. Provide tag with date and signature of factory service Engineer on inside cover of
- 25 each drive.
- 26 **3.2 INSTALLATION**
- 27 A. Install variable frequency drive equipment in accordance with the manufacturer's instructions.
- 28 B. Floor mount VFD on prefabricated or field fabricated supports with controls no higher than 6'-6" and no
- 29 lower than 3'-0" AFF. Mount supports on 1/2" thick vibration isolation pads set on concrete housekeeping
- 30 pads.
- 31 C. Provide engraved phenolic nameplates under the provisions of Section 26 05 53.
- 32 D. Connections: All conduit connections to the VFD shall be by flexible conduit.
- 33 E. Input, output, and control wiring shall each be run in separate conduits.
- 34 F. All interlocking required by the drive manufacturer shall be the responsibility of the Electrical Contractor.
- 35 **3.3 STARTUP AND COMMISSIONING**
- 36 A. Verify all settings, parameters, and adjustments with other contractors prior to startup. Make all
- 37 adjustments and setting to coordinate with controls and equipment.

- 1 B. Accelerate the motor to full speed and verify operation. Decelerate the motor to a stop and verify
2 operation. Slowly operate the motor over the speed range and check for resonance.
- 3 C. Make all adjustments and settings to coordinate with controls and equipment prior to Substantial
4 Completion. Verify that drive is set for auto restart after power loss and undervoltage fault.
- 5 D. Document settings in the Operations and Maintenance manual.

6 **END OF SECTION**

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"
6"	3/4"	5/8"
8" through 12"	7/8"	3/4"
14"	1"	7/8"
16" and 18"	1"	N/A
20" and 24"	1-1/4"	N/A

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 electroplated zinc finish.

2.2 PIPE AND STRUCTURAL SUPPORTS

- A. General:

- 1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58 and 127 (where applicable).
- 2. 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. Refer to insulation specifications for materials and additional information.

- 1 a. Insulation Couplings:
- 2 1) Insulation Coupling: Molded thermoplastic, -65°F to 275°F, sizes up to 4-1/8"
- 3 OD, and receive insulation thickness up to 1". Suitable for use indoors or
- 4 outdoors with UV stabilizers. Vertical insulation riser clamps shall have a
- 5 1,000lb/454kg vertical load rating. On cold pipes operating below 60°F/16°C,
- 6 cover joint and coupling with vapor barrier mastic to ensure continuous vapor
- 7 barrier.
- 8 2) Horizontal Strut Mounted Insulated Pipe:
- 9 a) Acceptable Manufacturers: Klo-Shure or equal.
- 10 3) Vertical:
- 11 a) Acceptable Manufacturers: Klo-Shure Titan or equal.
- 12 B. Vertical Supports:
- 13 1. Support and laterally brace vertical pipes at every floor level in multi-story structures, unless
- 14 otherwise noted by applicable codes, but never at intervals over 15 feet. Support vertical pipes with
- 15 riser clamps installed below hubs, couplings, or lugs. Provide sufficient flexibility to accommodate
- 16 expansion and contraction to avoid compromising fire barrier penetrations or stressing piping at
- 17 fixed takeoff locations.
- Acceptable Products:
- Cooper/B-Line - Fig B3373 Series
- Erico - 510 Series
- Nibco/Tolco - Fig. 82
- 18 2. Place restrained neoprene mounts beneath vertical pipe riser clamps to prevent sweating of cold
- 19 pipes. Select neoprene mounts based on the weight of the pipe to be supported. Insulate over
- 20 mounts.
- 21 Acceptable Products: Mason RBA, RCA, or BR.
- 22 3. Wall supports shall be used where vertical height of structure exceeds minimum spacing
- 23 requirements. Install wall supports at same spacing as hangers or strut supports along vertical
- 24 length of pipe runs. Wall supports shall be coordinated with the Structural Engineer.
- 25 4. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping
- 26 masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors
- 27 designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated
- 28 fasteners, wooden plugs, or plastic inserts
- 29 C. Hangers and Clamps:
- 30 1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass
- 31 through unbroken. This applies to both hot and cold pipes.
- 32 2. Hangers in direct contact with copper pipe shall be coated with plastic with appropriate
- 33 temperature range. Hydra-Zorb clamps are permitted for this application for bare pipes within their
- 34 temperature limits of -65°F to +275°F.
- 35 3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.

1 4. Ferrous hot piping 2-1/2 inches and larger shall have steel saddles tack welded to the pipe at each
 2 support with a depth not less than specified for the insulation. Factory fabricated inserts may be
 3 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

4 5. As an alternative to separate pipe insulation insert and saddle, properly sized integral rigid
 5 insulation sections may be used.

Acceptable Products:

- Cooper/B-Line - Fig. B3380 through B3384
- Pipe Shields - A1000, A2000
- Erico - Model 124, 127

6 6. Unless otherwise indicated, hangers shall be as follows:

a. Clevis Type:

- Service: Bare Metal Pipe
 Rigid Plastic 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

b. 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

c. Continuous Channel with Clevis Type:

- Service: Soft Copper Tubing

Acceptable Products:

- Cooper/B-Line - Fig. B3106, with Fig. B3106V
- Erico - Model 104, with Model 104V
- Nibco/Tolco - Fig. 1V

1 2	d.	<u>Adjustable Swivel Ring Type:</u>		
		Service:	Bare Metal Pipe - 4 inches and Smaller	
		<u>Acceptable Products:</u>	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

3 7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter
4 shall be secured to strut with clamps of proper design and capacity as required to maintain spacing
5 and alignment. Strut shall be independently supported from hanger drops or building structure. Size
6 and support shall be per manufacturer's installation requirements for structural support of piping.
7 Clamps shall not interrupt piping insulation.

8 a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-
9 plated zinc finish.

10 b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized
11 finish applied after fabrication.

12 8. Unless otherwise indicated, pipe supports for use with struts shall be as follows:

13 14 15 16	a.	<u>Clamp Type:</u>		
		Service:	Bare Metal Pipe Insulated Cold Pipe Insulated Hot Pipe - 3 inches and smaller	

17 1) Clamps in direct contact with copper pipe shall be plastic coated.

18 2) Pipes subject to expansion and contraction shall have clamps oversized to allow
19 limited pipe movement.

		<u>Acceptable Products:</u>	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	

20 D. Upper (Structural) Attachments:

21 1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:

22 2. Steel Structure Clamps

23 a. C-Type Wide Flange Beam Clamps (for use on top and/or bottom of wide flanges. Not
24 permitted for use with bar-joists):

		<u>Acceptable Products:</u>	
		Anvil	Fig. 92
		Cooper/B-Line	Fig. B3033/B3034
		Erico	Model 300
		Nibco/Tolco	68

- 1 f. Pump
2 g. VRF Compressors
- 3 C. Supports:
- 4 1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all
5 suspended material, equipment and conduit without sag.
- 6 2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete
7 inserts, furnished and installed by the Contractor whose work requires them, except where
8 indicated otherwise.
- 9 D. Grout:
- 10 1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise
11 indicated on the drawings or approved by the Architect/Engineer.
- 12 2. Use Mix No. 1 for clearances of 1" or less, and Mix No. 2 for all larger clearances.
- 13 3. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the
14 drawings.

15 **2.4 OPENINGS IN FLOORS, WALLS AND CEILINGS**

- 16 A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and
17 given to the General Contractor for installation or construction as the structure is built.
- 18 B. Coordinate all openings with other Contractors.
- 19 C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing
20 structures, or openings in new structures that were not installed, or additional openings. Repair all spalling
21 and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to
22 ensure even and uniform opening edges.
- 23 D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other
24 Contractors shall not exempt the Contractor from providing openings at his expense.
- 25 E. Do not cut structural members without written approval of the Architect or Structural Engineer.

26 **2.5 ROOF PENETRATIONS**

- 27 A. Seal pipes with surface temperature below 150°F penetrating single-ply roofs with conical stepped pipe
28 flashings and stainless steel clamps equal to Portals Plus Pipe Boots. Material shall match roofing membrane.
- 29 B. Break insulation only at the clamp for pipes between 60°F and 150°F. Seal outdoor insulation edges
30 watertight.

31 **2.6 SLEEVES AND LINTELS**

- 32 A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's
33 work in masonry walls and floors, unless specifically shown as being by others.
- 34 B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide
35 continuous sleeve. Cut or split sleeves are not acceptable.
- 36 C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all
37 lintels approved by the Architect or Structural Engineer.

- 1 D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends
2 extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring
3 closing floor plates.
- 4 E. Sleeves shall not penetrate structural members or masonry walls without approval from the Structural
5 Engineer. Sleeves shall then comply with the Architect/Engineer's design.
- 6 F. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with
7 sufficient annular space around material passing through opening so slight settling will not place stress on the
8 material or building structure.
- 9 G. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is
10 responsible for sleeves dislodged or moved when pouring concrete.
- 11 H. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint
12 material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at the point of penetration.
13 Secure to prevent shifting during concrete placement and finishing.
- 14 I. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation
15 wrapping.

16 **2.7 ESCUTCHEON PLATES AND TRIM**

- 17 A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of
18 finished rooms.
- 19 B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy
20 spring clip, rigid hinge and latch.
- 21 C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction
22 edges of all rectangular openings in finished rooms. This includes pipe openings.

23 **2.8 PIPE PENETRATIONS**

- 24 A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material
25 may be used.
- 26 B. Seal fire rated wall and floor penetrations with fire seal system as specified.

27 **2.9 PIPE ANCHORS**

- 28 A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be
29 supported, guided, aligned, and anchored as required.
- 30 B. Repair all piping leaks and associated damage. Pipes shall not rub on any part of the building.

31 **2.10 FINISH**

- 32 A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and
33 suspended ceiling spaces are not considered exposed.

34 **PART 3 - EXECUTION**

35 **3.1 HVAC SUPPORTS AND ANCHORS**

- 36 A. General Installation Requirements:
- 37 1. Install all items per manufacturer's instructions.

- 1 2. Coordinate the location and method of support of piping systems with all installations under other
2 Divisions and Sections of the Specifications.
- 3 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and
4 apply one coat of zinc rich primer to welding.
- 5 B. Supports Requirements:
- 6 1. Install roof pipe supports to resist wind movement per manufacturer's recommendations. Method
7 of securing base to roof shall be compatible with roofing materials.
- 8 2. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach
9 to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during
10 pipe installation.
- 11 3. Set all concrete inserts in place before pouring concrete.
- 12 4. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not
13 shown on the Drawings as being by others.
- 14 5. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts
15 and required accessories.
- 16 6. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.
- 17 C. Pipe Requirements:
- 18 1. Support all piping and equipment, including valves, strainers, traps and other specialties and
19 accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in
20 the piping or building structure during erection, cleaning, testing and normal operation of the
21 systems.
- 22 2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent
23 proper movement due to expansion and contraction.
- 24 3. Support piping at equipment and valves so they can be disconnected and removed without further
25 supporting the piping.
- 26 4. Piping shall not introduce strains or distortion to connected equipment.
- 27 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and
28 hanger rods; otherwise, pipes shall be supported with individual hangers.
- 29 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
- 30 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers,
31 at equipment connections and heavy fittings.
- 32 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical
33 couplings.
- 34 D. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not
35 extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- 36 E. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof
37 decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include
38 adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved,
39 supplemental framing off steel framing will need to be added.

- 1 F. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- 2 G. Spacing of Hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall
- 3 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"
2.	Steel (Std. Weight or Heavier – Vapor Service):	
	1-1/4" and under	9'-0"
	1-1/2"	12'-0"
	2" & larger	12'-0"
3.	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"
4.	Hard Drawn Copper & Brass (Vapor Service):	
	3/4" & under	7'-0"
	1"	8'-0"
	1-1/4"	9'-0"
	1-1/2"	10'-0"
	2"	11'-0"
	2-1/2" & larger	12'-0"

- 4 5. Soft Copper Tubing:
- 5 a. Continuous channel with hangers maximum 8'-0" OC.
- 6 6. Rigid Plastic Pipe:
- 7 a. Hangers shall be spaced based on the piping system manufacturers' instructions or, if no
- 8 system instructions are available, space hangers at 4'-0" maximum centers.
- 9 7. Installation of hangers shall conform to MSS SP-58.

10 **END OF SECTION**

1
2
SECTION 23 05 48
HVAC VIBRATION ISOLATION

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Bases.
6 B. Vibration Isolation.
7 C. Flexible Connectors.

8 **1.2 SUBMITTALS**

- 9 A. Submit shop drawings per Section 23 05 00 and the Vibration Isolation Submittal Form at the end of this
10 section.
11 B. Vibration isolation submittals may be included with equipment being isolated, but must comply with this
12 section.
13 C. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.
14 D. Isolator submittals shall include:
15 1. Equipment served
16 2. Type of Isolator
17 3. Load in Pounds per Isolator
18 4. Recommended Maximum Load for Isolator
19 5. Spring Constants of Isolators (for Spring Isolators)
20 6. Load vs. Deflection Curves (for Neoprene Isolators)
21 7. Specified Deflection
22 8. Deflection to Solid (at least 150% of calculated deflection)
23 9. Loaded (Operating) Deflection
24 10. Free Height
25 11. Loaded Height
26 12. K_x/K_y (horizontal to vertical stiffness ratio – for spring isolators)
27 13. Materials and Coatings
28 14. Spring Diameters
29 E. Make separate calculations for each isolator on equipment where the load is not equally distributed.
30 F. Flexible connector shop drawings shall include overall face-to-face length and all specified properties.

31 **PART 2 - PRODUCTS**

32 **2.1 BASIC CONSTRUCTION AND REQUIREMENT**

- 33 A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load
34 can be verified.
35 B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the
36 deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection [e.g., 3"
37 for 2" calculated deflection]. The point of 50% additional deflection shall not exceed the recommended load
38 rating of the isolator.
39 C. The lateral to vertical stiffness ratio (K_x/K_y) of spring isolators shall be between 0.8 and 2.0.

- 1 D. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.
- 2 E. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding
3 slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and
4 washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts,
5 nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior
6 use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip
7 galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.
- 8 F. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets
9 shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings.
10 Steel bases shall have at least four points of support.
- 11 G. All isolators, except M1, shall have provision for leveling.
- 12 **2.2 MOUNTINGS**
- 13 A. Type M1:
- 14 1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and
15 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load
16 requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35".
- 17 2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down,
18 prevent short circuiting with neoprene bushings and washers between bolts and isolators.
- 19 3. Acceptable Manufacturers: Mason "Super W", Kinetics "NGS", Amber/Booth "SPNR", Vibration
20 Eliminator Co. "400N".
- 21 B. Type M2:
- 22 1. Double deflection neoprene with minimum static deflection of 0.15" at calculated load and 0.35"
23 at maximum rated load.
- 24 2. All metal shall be neoprene covered. Mounting shall have friction pads both top and bottom.
- 25 3. All units shall have bolt holes and be bolted down.
- 26 4. Use steel rails above the mountings to compensate for the overhang of equipment such as small
27 vent sets and close coupled pumps.
- 28 5. Acceptable Manufacturers: Mason Industries "ND" or "DNR", Amber/Booth "RVD", Kinetics "RD",
29 Vibration Mountings and Controls "RD", Vibration Eliminator Co. "T22" or "T44".
- 30 C. Type M3:
- 31 1. Free standing, laterally stable spring isolators without housings and complete with 1/4" neoprene
32 friction pads.
- 33 2. Units shall have bolt holes but need not be bolted down unless called for or needed to prevent
34 movement. If bolted down, prevent short circuiting with neoprene bushings and washers between
35 bolts and isolators. Bolt holes shall not be within the springs.
- 36 3. All mountings shall have leveling bolts.
- 37 4. Acceptable Manufacturers: Mason "SLFH", Kinetics "FDS", Amber/Booth "SW-3, 4", 5" or 6",
38 Vibration Eliminator Co. "OST".

1 **2.3 HANGERS**

2 A. Type H1:

- 3 1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing
4 or oversized opening to prevent steel-to-steel contact.
- 5 2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.
- 6 3. Provide hangers with end connections as required for hanging ductwork or piping.
- 7 4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics "RH", Aeroflex "RHD", Vibration
8 Eliminator Co. "ALH".

9 B. Type H2:

- 10 1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short
11 circuiting the hanger rod.
- 12 2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
- 13 3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod
14 to swing through a 30° arc before contacting the grommet and short circuiting the spring.
- 15 4. Provide end connections for hanging ductwork or piping.
- 16 5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics "SRH", Amber/Booth "BSRA", Aeroflex
17 "RSH", Vibration Eliminator Co. "SNC".

18 C. Type H3:

- 19 1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short
20 circuiting of the hanger rod.
- 21 2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
- 22 3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod
23 to swing through a 30° arc before contacting the grommet and short circuiting the spring.
- 24 4. Provide end connections for hanging ductwork or piping.
- 25 5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall
26 have a secondary adjustment to transfer the load to the spring and maintain the same position.
- 27 6. Deflection shall be indicated by a pointer and scale.
- 28 7. Acceptable Manufacturer: Mason "PC30", Kinetics "SFH", Amber/Booth "BSW", Vibration
29 Eliminator Co. "PCS".

30 **2.4 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)**

31 A. Type FC1:

- 32 1. Spherical flexible connectors with multiple plies of nylon tire cord fabric and either EPDM or
33 molded and cured neoprene. Outdoor units shall be EPDM.
- 34 2. Steel aircraft cables or threaded steel rods shall be used to prevent excess elongation.

- 1 3. All straight through connections shall be made with twin-spheres properly pre-extended as
2 recommended by the manufacturer.
- 3 4. Connectors up to 2" size may have threaded ends.
- 4 5. Connectors 2-1/2" and over shall have floating steel flanges recessed to lock raised face neoprene
5 flanges.
- 6 6. All connectors shall be rated for a minimum working pressure of 150 psi at 200°F.
- 7 7. Acceptable Manufacturer: Metraflex "Double Cable-Sphere", Minnesota Flex Corp., Mercer "200
8 Series", Twin City Hose "MS2".

9 **PART 3 - EXECUTION**

10 **3.1 GENERAL INSTALLATION**

- 11 A. Install all products per manufacturer's recommendations.
- 12 B. Provide vibration isolation as indicated on the drawings and as described herein.
- 13 C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason
14 Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from
15 baseplates with neoprene washers and bushings.
- 16 D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection
17 of the isolator under the weight of the installed equipment - not the maximum rated deflection of the
18 isolator.
- 19 E. Support equipment to be mounted on structural steel frames with isolators under the frames or under
20 brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.
- 21 F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support
22 points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

23 **3.2 PIPE ISOLATION**

- 24 A. The first three hangers from vibration-isolated equipment shall be type H1.
- 25 B. For base mounted pumps without resilient mountings, the first five hangers shall be Type H1.
- 26 C. Where piping is floor-supported, use M2 instead of H1 and M3 instead of H2.
- 27 D. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans,
28 base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply
29 that they are not required.
- 30 E. Use Type FC1 where pressures are lower than 150 psi, temperatures are below 220°F, and the fluid handled
31 is compatible with neoprene and EPDM.
- 32 F. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with
33 appropriate temperature and pressure ratings.
- 34 G. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections
35 or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during
36 installation. Do not transfer load to the isolators until the installation is complete and under full operational
37 load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.

1 H. Support piping to prevent extension of flexible connectors.

2 **3.3 VIBRATION ISOLATION OF DUCTWORK**

3 A. The first three hangers on the DOAS shall be Type H1 with at least 0.20" minimum static deflection.

4 B. Provide flexible duct connections as described in Section 23 33 00 at all fan inlets and outlets and on the
5 mechanical room side of all locations where ducts penetrate mechanical room walls.

6 **3.4 VIBRATION ISOLATION SCHEDULE**

EQUIPMENT DESIGNATION	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION	FLEXIBLE CONNECTIONS
Base Mounted Pump(s)	NA	NA	NA	FC-1
VRF Indoor Ducted Units	NA	H1	.75"	Per Section 23 33 00
Water Cooled Compressors	NA	M1	NA	FC-1

7

8 Note 1: AHU internal fan isolation shall be determined by AHU manufacturer. Isolation selected shall be a minimum of 98%
9 efficient at scheduled CFM and static pressure.

10

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:
 1. When submitting hangers or supports for a weight range, fill in two rows - one for the maximum and one for the minimum weight.

**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>OD 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. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.

- F. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.

- G. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

- H. Stencil Painted Pipe Markers: Use industrial enamel spray paint per ANSI Standard A13.1. Indicate fluid conveyed and flow direction.

- I. 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.

- J. Tracer Wire:

1. Single copper conductors shall be solid or stranded annealed or hard uncoated copper per UL83 and ASTM requirements. Tracer tape or copper-coated steel wire is not acceptable.

- 1 2. Conductor shall be insulated with HMWPE as specified and applied in a concentric manner. The
2 minimum at any point shall not be less than 90% of the specified average thickness in compliance
3 with UL 83.
- 4 3. Tracer wire shall be continuously spark tested at 7500 Volts DC. Other electrical and mechanical
5 tests shall be in accordance with UL 1581.
- 6 K. Marker Balls:
- 7 1. The 3M ScotchMark Electronic Ball Marker System Extended Range Marker (model#1404-XR) shall
8 be considered an acceptable marker device for this specification. If an alternate equivalent marker
9 is selected, contractor shall provide specifications and data sheets of the selected device to City
10 Engineering prior construction in order for the City to confirm that the proposed marker device is
11 compatible with the City's marking equipment. Coordinate marker ball color with City of Madison.

12 **PART 3 - EXECUTION**

13 **3.1 INSTALLATION**

- 14 A. Install all products per manufacturer's recommendations.
- 15 B. Degrease and clean surfaces to receive adhesive for identification materials.
- 16 C. Valves:
- 17 1. All valves (except shutoff valves at equipment) shall have numbered tags.
- 18 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that
19 have been revised.
- 20 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag
21 numbering sequence with the Owner prior to ordering tags.
- 22 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic
23 straps.
- 24 5. Attach to handwheel or around valve stem. On lever operated valves, drill the lever to attach tags.
- 25 6. Number all tags and show the service of the pipe.
- 26 7. Provide two sets of laminated 8-1/2" x 11" copies of a valve directory listing all valves, with
27 respective tag numbers, uses, and locations. The directory shall be reviewed by the Owner and
28 Architect/Engineer prior to laminating final copies. Laminated copies shall have brass eyelet in at
29 least one corner for easy hanging.
- 30 D. Pipe Markers:
- 31 1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady
32 Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are
33 acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely
34 around the pipe.
- 35 2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon
36 or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.

- 1 3. Stencil Painted Pipe Markers:
- 2 a. Remove rust, grease, dirt, and all foreign substances from the pipe surface.
- 3 b. Apply primer on non-insulated pipes before painting.
- 4 c. Use background and letter colors as scheduled later in this section.
- 5 4. Apply markers and arrows in the following locations where clearly visible:
- 6 a. At each valve.
- 7 b. On both sides of walls that pipes penetrate.
- 8 c. At least every 20 feet along all pipes.
- 9 d. On each riser and each leg of each "T" joint.
- 10 e. At least once in every room and each story traversed.
- 11 5. Underground Pipe Markers: Install 8" to 10" below grade, directly above buried pipes.
- 12 E. Equipment:
- 13 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an
- 14 area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers,
- 15 etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label
- 16 exposed equipment in public areas.
- 17 2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding
- 18 cement.
- 19 3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act
- 20 (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the
- 21 equipment complies with the requirements of ASHRAE 90.1.
- 22 F. Miscellaneous:
- 23 1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on
- 24 fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate
- 25 damper type.
- 26 G. Tracer Wire:
- 27 1. Tracer wire shall be installed on top of all non-metallic buried utilities.
- 28 2. Tracer wire shall be taped directly to plastic water or drain pipe.
- 29 3. Tracer wire shall not be fastened directly or indirectly to gas piping.
- 30 4. Tracer wire when attached shall be secured to the pipe a minimum of every 10 feet and at all
- 31 changes of direction.
- 32 5. Tape shall be Polyken "930-35", Protecto-Wrap "310", or approved equal.
- 33 6. Tracer wire shall be continuous between boxes and shall be tested for continuity.
- 34 7. Splices in tracer wire shall be made with a water proof splice kit to prevent corrosion. Wire nuts
- 35 shall not be used.
- 36 8. The tracer wire shall daylight to grade in an irrigation box, at the point of the utility entrance to
- 37 building. Irrigation box shall be labeled as future contact point to locate the utility.

1 **3.2 SCHEDULE**

2 A. Pipes to be marked shall be labeled with the text as shown in the following table regardless of which method
3 or material is used:

Pipe Service	Lettering Color	Background Color
GEOTHERMAL WATER SUPPLY	White	Green
GEOTHERMAL WATER RETURN	White	Green
CONDENSATE DRAIN	Black	Yellow
REFRIGERANT LIQUID	Black	Yellow
REFRIGERANT SUCTION	Black	Yellow
REFRIGERANT HOT GAS	Black	Yellow
Underground Piping	Varies	Varies
Tracer Wire - Geothermal	----	Green

4 **END OF SECTION**

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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.

1 B. Include in the final report a schematic drawing showing each system component, including balancing devices,
2 for each system. Each drawing shall be included with the test reports required for that system. The schematic
3 drawings shall identify all testing points and cross-reference these points to the report forms and procedures.

4 C. Refer to PART 4 for required reports.

5 **1.6 WARRANTY/GUARANTEE**

6 A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed
7 balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet,
8 coil, or device listed in the test report. This warranty shall provide a minimum of 24 man-hours of onsite
9 service time. If it is determined that the new test results are not within the design criteria, the balancer shall
10 rebalance the system according to design criteria.

11 B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance
12 Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

13 **1.7 SCHEDULING**

14 A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the
15 Architect/Engineer prior to performing each test.

16 **PART 2 - PRODUCTS**

17 NOT APPLICABLE

18 **PART 3 - EXECUTION**

19 **3.1 GENERAL REQUIREMENTS**

20 A. All procedures must conform to a published standard listed in the References article of this section. All
21 equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed
22 in this specification but installed under the contract documents shall be balanced using a procedure from a
23 published standard listed in the References article.

24 B. Recorded data shall represent actual measured or observed conditions.

25 C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent
26 necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe
27 holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.

28 D. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be
29 restored. Set and lock memory stops.

30 E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical
31 switch boxes, plugging test holes, and restoring thermostats to specified settings.

32 F. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to
33 match. Refer to Section 23 09 00 for additional information.

34 G. Installations with systems consisting of multiple components shall be balanced with all system components
35 operating.

1 **3.2 EXAMINATION**

2 A. Before beginning work, verify that systems are complete and operable. Ensure the following:

3 1. General Equipment Requirements:

- 4 a. Equipment is safe to operate and in normal condition.
- 5 b. Equipment with moving parts is properly lubricated.
- 6 c. Temperature control systems are complete and operable.
- 7 d. Proper thermal overload protection is in place for electrical equipment.
- 8 e. Direction of rotation of all fans and pumps is correct.
- 9 f. Access doors are closed and end caps are in place.

10 2. Duct System Requirements:

- 11 a. All filters are clean and in place. If required, install temporary media.
- 12 b. Duct systems are clean and free of debris.
- 13 c. Fire/smoke and manual volume dampers are in place, functional and open.
- 14 d. Air outlets are installed and connected.
- 15 e. Duct system leakage has been minimized.

16 3. Pipe System Requirements:

- 17 a. Coil fins have been cleaned and combed.
- 18 b. Hydronic systems have been cleaned, filled, and vented.
- 19 c. Strainer screens are clean and in place.
- 20 d. Shutoff, throttling and balancing valves are open.

21 B. Report any defects or deficiencies to Architect/Engineer.

22 C. Promptly report items that are abnormal or prevent proper balancing.

23 D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

24 E. Beginning of work means acceptance of existing conditions.

25 **3.3 PREPARATION**

26 A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to
27 the Architect/Engineer for spot checks during testing.

28 B. Instruments shall be calibrated within six months of testing performed for project, or more recently if
29 recommended by the instrument manufacturer.

30 **3.4 INSTALLATION TOLERANCES**

31 A. ± 10% of scheduled values:

32 1. Adjust air inlets and outlets to ± 10% of scheduled values.

33 2. Adjust piping systems to ± 10% of design values.

34 B. + 5% of scheduled values

35 1. Adjust outdoor air intakes to within + 5% of scheduled values.

36 2. Adjust exhaust air through energy recovery equipment to within +5% of scheduled values.

1 C. Adjust supply, return, and exhaust air-handling systems to +10% / -5% of scheduled values.

2 **3.5 ADJUSTING**

3 A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been
4 rectified.

5 B. Once balancing of systems is complete, at least one damper or valve must be 100% open.

6 C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements
7 to verify system is operating as reported in the report. Document any discrepancies.

8 D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with
9 contractor.

10 E. Contractor responsible for pump shall trim impeller or order new impeller to final duty point as instructed by
11 this contractor on all pumps not driven by a VFD. Coordinate with contractor.

12 **3.6 SUBMISSION OF REPORTS**

13 A. Fill in test results on appropriate forms.

14 **PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED**

15 **4.1 GENERAL REQUIREMENTS**

16 A. Title Page:

- 17 1. Project name.
18 2. Project location.
19 3. Project Architect.
20 4. Project Engineer (KJWW Engineering Consultants).
21 5. Project General Contractor.
22 6. TAB Company name, address, phone number.
23 7. TAB Supervisor's name and certification number.
24 8. TAB Supervisor's signature and date.
25 9. Report date.

26 B. Report Index

27 C. General Information:

- 28 1. Test conditions.
29 2. Nomenclature used throughout report.
30 3. Notable system characteristics/discrepancies from design.
31 4. Test standards followed.
32 5. Any deficiencies noted.
33 6. Quality assurance statement.

34 D. Instrument List:

- 35 1. Instrument.
36 2. Manufacturer, model, and serial number.
37 3. Range.
38 4. Calibration date.

- 1 **4.2 AIR SYSTEMS**
- 2 A. Air Moving Equipment:
- 3 1. General Requirements:
- 4 a. Drawing symbol.
- 5 b. Location.
- 6 c. Manufacturer, model, arrangement, class, discharge.
- 7 d. Fan RPM.
- 8 e. Multiple RPM fan curve with operating point marked. (Obtain from equipment supplier).
- 9 f. Final frequency of motor at maximum flow rate (on fans driven by VFD).
- 10 2. Flow Rate:
- 11 a. Supply flow rate (cfm): specified and actual.
- 12 b. Return flow rate (cfm): specified and actual.
- 13 c. Outside flow rate (cfm): specified and actual.
- 14 d. Exhaust flow rate (cfm): specified and actual.
- 15 3. Pressure Drop and Pressure:
- 16 a. Filter pressure drop: specified and actual.
- 17 b. Total static pressure: specified and actual. (Indicate if across fan or external to unit).
- 18 c. Inlet pressure.
- 19 d. Discharge pressure.
- 20 B. Fan Data:
- 21 1. Drawing symbol.
- 22 2. Location.
- 23 3. Manufacturer and model.
- 24 4. Flow rate (cfm): specified and actual.
- 25 5. Total static pressure: specified and actual. (Indicate measurement locations).
- 26 6. Inlet pressure.
- 27 7. Discharge pressure.
- 28 8. Fan RPM.
- 29 C. Electric Motors:
- 30 1. Drawing symbol of equipment served.
- 31 2. Manufacturer, Model, Frame.
- 32 3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
- 33 4. Measured: Amps in each phase.
- 34 D. Air Terminal (Inlet or Outlet):
- 35 1. Drawing symbol.
- 36 2. Room number/location.
- 37 3. Terminal type and size.
- 38 4. Velocity: specified and actual.
- 39 5. Flow rate (cfm): specified and actual.
- 40 6. Percent of design flow rate.
- 41 E. Air Terminal Unit (Terminal Air Box) Data:
- 42 1. General Requirements:
- 43 a. Drawing symbol.
- 44 b. Location.
- 45 c. Manufacturer and model.
- 46 d. Size.
- 47 e. Type: constant, variable, single, dual duct.

- 1 2. Flow Rate:
- 2 a. Cooling maximum flow rate (cfm): specified and actual.
- 3 b. Minimum flow rate (cfm): specified and actual.
- 4 3. Pressure Drop and Pressure:
- 5 a. Inlet static pressure during testing (maximum and minimum).

6 **4.3 HEATING SYSTEMS**

- 7 A. Pump Data (Heating water Loop Pumps):
- 8 1. Existing drawing symbol or equipment TAG
- 9 2. Service.
- 10 3. Manufacturer, size, and model.
- 11 4. Impeller size: specified, actual, and final (if trimmed).
- 12 5. Flow Rate (gpm): specified and actual.
- 13 6. Pump Head: specified, operating and shutoff.
- 14 7. Suction Pressure: Operating and shutoff.
- 15 8. Discharge Pressure: Operating and shutoff.
- 16 9. Final frequency of motor at maximum flow rate (on pumps driven by VFD).

- 17 B. Electric Motors (Associated Heating Water Loop Pump Motors):
- 18 1. Drawing symbol of equipment served.
- 19 2. Manufacturer, Model, Frame.
- 20 3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
- 21 4. Measured: Amps in each phase.

- 22 C. Heating Coils:
- 23 1. General Requirements:
- 24 a. Drawing symbol.
- 25 b. Service.
- 26 c. Location.
- 27 d. Manufacturer and model.
- 28 e. Size.
- 29 2. Flow Rate:
- 30 a. Flow rate (cfm): specified and actual.
- 31 b. Water flow rate: specified and actual.
- 32 3. Temperature:
- 33 a. Entering air temperature: specified and actual.
- 34 b. Leaving air temperature: specified and actual.
- 35 c. Entering water temperature: specified and actual.
- 36 d. Leaving water temperature: specified and actual.
- 37 4. Pressure Drop and Pressure:
- 38 a. Air pressure drop: specified and actual.
- 39 b. Steam pressure after valve: specified and actual.
- 40 c. Water pressure drop: specified and actual.

- 41 D. DX Cooling Coils:
- 42 1. General Requirements:
- 43 a. Drawing symbol.
- 44 b. Service.
- 45 c. Location.
- 46 d. Manufacturer and model.
- 47 e. Size.
- 48 2. Flow Rate:
- 49 a. Flow rate (cfm): specified and actual.

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- 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).

9 **END OF SECTION**

**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.

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.

- 1 2. Cut slightly longer than perimeter of duct to insure full thickness at corners. Do not wrap excessively
2 tight.
- 3 3. Seal joints with adhesive backed tape.
- 4 4. Apply so insulation conforms uniformly and firmly to duct.
- 5 5. Provide high-density insulation inserts at trapeze duct hangers and straps to prevent crushing of
6 insulation. Maintain continuous vapor barrier through the hanger.
- 7 6. Tape all joints with Royal Tapes #RT 350 (216-439-7229), Venture Tape 1525CW, or Compac Type
8 FSK. No substitutions will be accepted without written permission from the Architect/Engineer.
- 9 7. Press tape tightly to the duct covering with a squeegee for a tight continuous seal. Fish mouths and
10 loose tape edges are not acceptable.
- 11 8. Staples may be used, but must be covered with tape.
- 12 9. Vapor barrier must be continuous.
- 13 10. Mechanically fasten on 12" centers at bottom of ducts over 24" wide and on all sides of vertical
14 ducts.
- 15 F. Semi Rigid Fiberglass Board Wrap - Type B (Indoor Use):
- 16 1. Impale on pins welded to the duct and secured with speed clips. Clip pins off close to speed clips.
- 17 2. Space pins as needed to hold insulation firmly against duct, but not less than one pin per square
18 foot. Pins must be long enough to avoid compressing the insulation.
- 19 3. Seal all joints and speed clips with glass fabric set in adhesive or a 3" wide strip of Royal Tapes #RT
20 350 (216-439-7229), Venture Tape 1525CW, or Compac Type FSK facing tape.
- 21 4. For small areas, secure insulation with adhesive over the entire surface of the duct. Use adhesive in
22 addition to pins as needed to prevent sagging on horizontal surfaces.
- 23 G. Interior Insulation - Flexible Duct Liner, Type C:
- 24 1. Observation of Duct Lining:
- 25 a. After installation of ductwork, Architect/Engineer may select random observation points
26 in each system.
- 27 1) At each observation point, cut and remove an 18" x 18" section of ductwork and
28 liner for verification of installation.
- 29 2) Random observation points based on one opening per 75 lineal ft. of total duct
30 run.
- 31 b. When any of the observation points shows non-compliance, additional points will be
32 designated by the Architect/Engineer, and observation repeated.
- 33 c. If 20% of points observed do not comply, remove and replace all lined ducts and repeat
34 tests. Where replacement is not required, correct all non-compliances.
- 35 d. At end of observation, repair all duct lining and observation holes by installing standard,
36 insulated, hinged access doors per Section 23 33 00.

- 1 e. Paint or finish to match adjacent duct surfaces.
- 2 2. Impale on spindle anchors welded or mechanically fastened to the duct. Adhesive or glue fastened
3 anchors are not acceptable. Maximum anchor spacing per SMACNA Duct Construction Standards
4 or manufacturer's recommendations, whichever is more restrictive. Locate pins less than 3" from
5 corners and at intervals not over 6" around the perimeter at leading and trailing edges. Locate pins
6 within 3" of transverse joints and at intervals not over 16" long the length of the duct. Pins must be
7 long enough to prevent compressing the insulation.
- 8 3. In addition to anchors, secure liner with UL listed adhesive covering over 90% of the duct surface.
- 9 4. Install per the latest edition of the SMACNA Manual.
- 10 5. Leading edges shall be covered as follows:
- 11 a. For duct velocities below 3000 fpm, coat leading edges with adhesive. Neatly butt liner
12 without gaps at transverse joints. Cut liner flush with end of the duct section for tight
13 joints with no exposed duct. If adhesive is shop installed, field apply additional adhesive
14 to the end of each duct section for complete adhesion of the liner. Protect edges from
15 dirt and debris.
- 16 b. For duct velocities above 3000 fpm, cover leading edges with metal nosing. Use nosing on
17 upstream edges of each section of duct. If the duct can be installed in either direction,
18 provide nosing on each end or clearly mark the duct to allow visual verification after
19 installation. Verify duct velocities based on the scheduled air flow rates and determine
20 where metal nosing is required.
- 21 c. Install metal nosing in the following locations (regardless of velocity):
- 22 1) The first three fittings downstream of all fans.
23 2) At all duct liner interruptions. This includes fire dampers, access doors, branch
24 connections, and all other locations where the edge of the liner is exposed.
25 3) Trailing edges of transverse joints do not require metal nosings.
- 26 6. Overlap liner at longitudinal joints. Make longitudinal joints at corners of the duct unless the duct
27 size does not allow this. Coat longitudinal joints with adhesive at velocities over 2500 fpm.
- 28 7. Seal all damaged duct liner with adhesive and glass cloth. Do not damage duct liner surface coatings.
- 29 8. Duct dimensions given are net inside dimensions. Increase sheet metal to allow for insulation
30 thickness.
- 31 H. Continue insulation with vapor barrier through penetrations unless code prohibits.
- 32 I. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally
33 insulated ductwork extending to a floor or curb.
- 34 **3.2 SCHEDULE**
- 35 A. Refer to Section 23 31 00 for scheduling of insulation.

36 **END OF SECTION**

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2
SECTION 23 07 16
HVAC EQUIPMENT INSULATION

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Equipment Insulation.
6 B. Equipment Insulation Finishes.

7 **1.2 QUALITY ASSURANCE**

- 8 A. Applicator: Company specializing in insulation application with five years minimum experience.
- 9 B. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255, or UL
10 723 (where required).
- 11 C. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants
12 used on the interior of the building must comply with the following requirements:
- 13 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management
14 District (SCAQMD) Rule #1168.
- 15 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36
16 requirements in effect on October 19, 2000.

17 **PART 2 - PRODUCTS**

18 **2.1 INSULATION**

- 19 A. Type E: Cellular Flexible Elastomeric Foam Sheet; ANSI/ASTM C534; 0.28 maximum 'K' value at 75°F; 25/50
20 flame spread/smoke developed when tested in accordance with ASTM E84 (UL 723).

21 **PART 3 - EXECUTION**

22 **3.1 INSTALLATION**

- 23 A. Install all materials per manufacturer's instructions, codes and industry standards.
- 24 B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.
- 25 C. Do not insulate factory insulated equipment.
- 26 D. Apply insulation as close as possible to equipment by grooving, scoring, and bevelling insulation. Secure to
27 equipment with studs, pins, clips, adhesive, wires, or bands.
- 28 E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold
29 equipment, use vapor barrier mastic.
- 30 F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting
31 insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided
32 to identify the presence of these items.
- 33 G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install
34 specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.

- 1 H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor.
2 Minimum 2" coverage of insulation.
- 3 I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60°F and/or
4 above 100°F. Verify insulation type and thickness with equipment manufacturer and Architect/Engineer.
- 5 J. Insulate all supports on equipment operating below ambient temperature.

6 **3.2 INSULATION**

- 7 A. Type E:
- 8 1. Apply with edges tightly butted and joints staggered. Install multiple layers if required thickness is
9 greater than 1" thick.
- 10 2. Do not wrap sheet insulation around square corners, but cut and overlap insulation at corners to
11 provide full insulation thickness on all sides. Seal all overlapping insulation surfaces with
12 manufacturer approved adhesive.
- 13 3. Secure with manufacturer approved adhesive in accordance with installation instructions. Where
14 applied to underside surfaces or on surfaces with temperatures 140°F and above, cover all surfaces
15 with full application of adhesive. Seal all joints and seams with manufacturer approved adhesive.

16 **3.3 SCHEDULE**

Equipment	Insulation Type	Insulation Thickness	Insulation Finish
A. Geothermal Water Air Separator/Coalescing Filter	E	1"	None
B. Geothermal Water Pumps	E	1"	None
C. Geothermal Expansion Tank	E	1"	None

17 **END OF SECTION**

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 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 1" thick per layer where multiple layers are specified.
- B. 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.

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.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

2.3 REMOVABLE INSULATION JACKETS

- A. Removable insulation jackets shall consist of outer covering, interstitial insulation material, and inner covering.
- B. Inner and outer covering shall be constructed from a minimum 16.5 oz/yd² PTFE fiberglass composite and suitable for insulating surface temperatures up to 550°F.

- 1 C. Interstitial insulation blanket shall be minimum 1-1/2" thick and shall consist of either:
- 2 1. Silica and glass-fiber insulation felts and blankets – minimum 6 lb/ft³ density.
- 3 2. E-type glass-fiber felts and blankets – minimum 6 lb/ft³ density.
- 4 D. Construction: Inner and outer covering with interstitial insulation material shall be joined into a single
- 5 assembly using a double sewn lock stitch with 4-6 stitches/inch. The thread used shall be able to withstand
- 6 minimum 550°F surface temperatures without degradation. The use of hog rings, staples, and wires for
- 7 closure of assembly are not acceptable. The interstitial insulation shall be sewn as an integral part of the inner
- 8 and outer coverings to prevent shifting of the insulation. Insulation pins are not an allowable method of
- 9 preventing the insulation from shifting and shall not be used.
- 10 E. No raw cut jacket edges shall be exposed.
- 11 F. Jackets shall be fastened to equipment and piping components using hook and loop (Velcro) straps and
- 12 minimum 1" slide buckles.
- 13 G. Jacket coverings shall have an inner covering edge with a continuous strip of hook & loop closure (Velcro)
- 14 that is parallel to the seam and overlaps the outer covering by a minimum of 2 inches.
- 15 H. Acceptable Manufacturers: Firwin Corp, Lewco Specialty Products, ThermaXX Jackets LLC or approved
- 16 equivalent.
- 17 **2.4 REFRIGERANT PIPE COUPLING**
- 18 A. Insulation Coupling: Molded thermoplastic ASTM D1525, -65°F to 275°F, sizes up to 4-1/8" O.D., and receive
- 19 insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers.
- 20 B. Acceptable Manufacturers: Klo-Shure or equal.

21 **PART 3 - EXECUTION**

22 **3.1 PREPARATION**

- 23 A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying
- 24 insulation.

25 **3.2 INSTALLATION**

- 26 A. General Installation Requirements:
- 27 1. Install materials per manufacturer's instructions, building codes and industry standards.
- 28 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping.
- 29 Maintain fire rating of all penetrations.
- 30 3. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining
- 31 insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing.
- 32 The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material,
- 33 and shall be a 180° cylindrical segment the same length as metal shields. Inserts shall be a cellular
- 34 glass (for all temperature ranges) or molded hydrous calcium silicate (for pipe with operating
- 35 temperatures above 70°F, with a minimum compressive strength of 50 psi. Factory fabricated
- 36 inserts may be used. Rectangular blocks, plugs, or wood material are **not** acceptable. Temporary
- 37 wood blocking may be used by the Piping Contractor for proper height; however, these must be
- 38 removed and replaced with proper inserts by the Insulation Contractor.
- 39 4. Neatly finish insulation at supports, protrusions, and interruptions.

1 5. Install metal shields between all hangers or supports and the pipe insulation. Shields shall be
2 galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping,
3 seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add
4 separate vapor barrier jacket.

5 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
e.	16" to 24"	24" long x 12 gauge

6 7. All piping and insulation that does not meet 25/50 that is located in an air plenum shall have written
7 approval from the Authority Having Jurisdiction and the local fire department for authorization and
8 materials approval. If approval has been allowed, the non-rated material shall be wrapped with a
9 product that has passed ASTM E84 and/or NFPA 255 testing with a rating of 25/50 or below.

10 B. Insulated Piping Operating Below 60°F:

11 1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and
12 expansion joints. Seal all penetrations of vapor barrier.

13 2. On piping operating below 60°F in locations that are not mechanically cooled (e.g., penthouses,
14 mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.

15 3. All balance valves with fluid operating below 60°F shall be insulated with a removable plug wrapped
16 with vapor barrier tape to allow reading and adjusting of the valve.

17 C. Insulated Piping Operating Between 60°F and 140°F:

18 1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate
19 all fittings, valves and strainers.

20 D. Insulated Piping Operating Above 140°F:

21 1. Insulate fittings, valves, flanges, float & thermostatic steam traps, and strainers. On gate valves,
22 the insulation shall be extended to cover the entire valve bonnet, leaving only the portion of the
23 stem that is above the bonnet and valve operator exposed.

24 2. All balance valves with fluid operating above 140°F shall be insulated and an opening shall be left
25 in the insulation to allow for reading and adjusting the valve.

26 3. The use of removable insulation jackets is acceptable for insulating large and non-cylindrical shaped
27 piping components (e.g., check valves, pressure regulating valves, calibrated balance valves, gate
28 valve bonnets, F&T traps, strainers, line sets, and the like).

29 E. Exposed Piping:

30 1. Locate and cover seams in least visible locations.

31 2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the
32 insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco
33 aluminum and shall fit tightly to the insulation.

- 1 F. VRF Systems:
- 2 1. Refer to 23 81 45 for additional requirements on VRF Systems.
- 3 **3.3 INSULATION**
- 4 A. Type B Insulation:
- 5 1. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without
6 slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use
7 mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed
8 completely and not pucker or wrinkle.
- 9 2. Self-seal insulation may be used on pipes operating below 170°F.
- 10 B. Type C Insulation:
- 11 1. Seal all longitudinal joints with manufacturer approved adhesive. Secure butt joint strips in a similar
12 manner.
- 13 2. Insulate fittings with prefabricated fittings.
- 14 **3.4 JACKET COVER INSTALLATION**
- 15 A. Plastic Covering:
- 16 1. Provide vapor barrier as specified for insulation type. Cover with plastic jacket covering. Position
17 seams to shed water.
- 18 2. Solvent weld all joints with manufacturer recommended cement.
- 19 3. Overlap all laps and butt joints 1-1/2" minimum. Repair any loose ends that do not seal securely.
20 Solvent weld all fitting covers in the same manner. Final installation shall be watertight.
- 21 4. Use plastic insulation covering on all exposed pipes including, but not limited to:
- 22 a. All exposed piping in areas noted on drawings.
- 23 b. All piping in mechanical rooms that is subject to damage from normal operations.
24 (Example: Piping that must be stepped over routinely.)

25 **3.5 SCHEDULE**

Piping System	Insulation Type/Thickness
A. Geothermal Water Supply & Return All Sizes	B / 1" (2 layers 1/2")
B. Refrigerant Gas	B / 1/2"
C. Refrigerant Suction Under 1-1/2" 1-1/2" and UP	B / 1/2" B / 1"
D. Insulation Inserts at hangers	C - Match pipe insulation thickness

26 **END OF SECTION**

**SECTION 23 09 00
CONTROLS**

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1 **PART 1 - GENERAL**

2 **1.1 SECTION INCLUDES**

- 3 A. Complete System of Automatic Controls.
4 B. Control Devices, Components, Wiring and Material.
5 C. Instructions for Owners.

6 **1.2 QUALITY ASSURANCE**

- 7 A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum
8 five years' experience.
- 9 B. TCC: Company specializing in the work of this section with minimum five years temperature control
10 experience.
- 11 C. Technician: Minimum five years' experience installing commercial temperature control systems.
- 12 D. TCCs are limited to firms regularly employing a minimum of five full-time temperature control technicians
13 within 50 miles of the job site.

14 **1.3 SUBMITTALS**

15 A. Equipment Coordination:

- 16 1. The Controls Contractor shall obtain approved equipment submittals from other contractors to
17 determine equipment wiring connections, to choose appropriate controllers, and to provide
18 programming.
- 19 2. Control valve selections shall be based on flow rates shown in approved shop drawings.
- 20 3. Coordinate the control interface of all equipment with the equipment manufacturers prior to
21 submittal submission.

22 B. Shop Drawings:

- 23 1. Submit shop drawings per Section 23 05 00. In addition, submit an electronic copy of the shop
24 drawings in Adobe Acrobat (.pdf) format to the Owner for review.
- 25 2. Cross-reference **all** control components and point names in a single table located at the beginning
26 of the submittal with the **identical** nomenclature used in this section.
- 27 3. Submittal shall also include a trunk cable schematic diagram depicting operator workstations,
28 control panel locations and a description of the communication type, media and protocol.
- 29 4. System Architecture: Provide riser diagrams of wiring between central control unit and all control
30 panels. This shall include specific protocols associated with each level within the architecture.
31 Identify all interface equipment between CPU and control panels. The architecture shall include
32 interface requirements with other systems including, but not limited to, security systems, lighting
33 control, fire alarm, elevator status, and power monitoring system.
- 34 5. Diagrams shall include:
- 35 a. Wiring diagrams and layouts for each control panel showing all termination numbers.

- 1 b. Schematic diagrams for all control, communication, and power wiring. Provide a
2 schematic drawing of the central system installation. Label all cables and ports with
3 computer manufacturers' model numbers and functions. Show all interface wiring to the
4 control system.
- 5 c. Identification of all control components connected to emergency power.
- 6 d. Schematic diagrams for all field sensors and controllers.
- 7 e. A schematic diagram of each controlled system. The schematics shall have all control
8 points labeled. The schematics shall graphically show the location of all control elements
9 in the system.
- 10 f. A schematic wiring diagram for each controlled system. Each schematic shall have all
11 elements labeled. Where a control element is the same as that shown on the control
12 system schematic, label it with the same name. Label all terminals.
- 13 g. A tabular instrumentation list for each controlled system. The table shall show element
14 name, type of device, manufacturer, model number and product data sheet number.
- 15 h. All installation details and any other details required to demonstrate that the system will
16 function properly.
- 17 i. All interface requirements with other systems.
- 18 6. The network infrastructure shall conform to the published guidelines for wire type, length, number
19 of nodes per channel, termination, and other relevant wiring and infrastructure criteria as
20 published. The number of nodes per channel shall be no more than 80% of the defined segment
21 (logical or physical) limit in order to provide future system enhancement with minimal
22 infrastructure modifications.
- 23 7. Sequences: Submit a complete description of the operation of the control system, including
24 sequences of operation. The description shall include and reference a schematic diagram of the
25 controlled system. **The wording of the control sequences in the submittal shall match verbatim
26 that included in the construction documents to ensure there are no sequence deviations from
27 that intended by the Architect/Engineer. Clearly highlight any deviations from the specified
28 sequences on the submittals.**
- 29 8. Points List Schedule: Submit a complete points list of all points to be connected to the TCS and
30 FMCS. The points list for each system controller shall include both inputs and outputs (I/O), point
31 number, the controlled device associated with the I/O point, the location of the I/O device, and
32 reference drawings. Where a control point is the same as that shown on the control system
33 schematic, label it with the same name. Points list shall specifically identify alarms, trends, event
34 history, archive, totalization, graphic points, and all mapped points from other systems (security
35 systems, lighting control, fire alarm, etc.). Provide points lists, point naming convention, and factory
36 support information for systems provided and integrated into the FMCS.
- 37 9. Damper Schedule: Schedule shall include a separate line for each damper and a column for each of
38 the damper attributes:
- 39 a. Damper Identification Tag.
40 b. Location.
41 c. Damper Type.
42 d. Damper Size.
43 e. Duct Size.
44 f. Arrangement.
45 g. Blade Type.
46 h. Velocity.

- 1 i. Pressure Drop.
2 j. Fail Position.
3 k. Actuator Identification Tag.
4 l. Actuator Type.
5 m. Mounting.
- 6 10. Valve Schedule: Valve manufacturer shall size valves and create a valve schedule. Schedule shall
7 include a separate line for each valve and a column for each of the valve attributes:
- 8 a. Valve Identification Tag.
9 b. Location.
10 c. Valve Type.
11 d. Valve Size.
12 e. Pipe Size.
13 f. Configuration.
14 g. Flow Characteristics.
15 h. Capacity.
16 i. Valve C_v.
17 j. Design Pressure Drop.
18 k. Pressure Drop at Design Flow.
19 l. Fail Position.
20 m. Close-off Pressure.
21 n. Valve and Actuator Model Number and Type.
- 22 11. Airflow Measuring Station Schedule:
- 23 a. The manufacturer's authorized representative shall prepare the airflow measuring station
24 submittal, or review and approve in writing the submittal prepared by the TCC prior to
25 submission to the Architect/Engineer and prior to installation. The representative shall
26 review air handling equipment submittals and duct fabrication drawings to ensure that all
27 AFMS locations meet the appropriate parameters to achieve proper installation and the
28 specified accuracy. Comply with all manufacturer's installation requirements including
29 straight up and downstream duct lengths. Install airflow straighteners if required by the
30 manufacturer based on installation constraints. The Architect/Engineer shall be notified
31 for approval of any deviations.
- 32 b. Submit product data sheets for airflow measuring devices indicating minimum placement
33 requirements, sensor density, sensor distribution, and installed accuracy to the host
34 control system.
- 35 c. Submit installation, operation, and maintenance documentation.
- 36 12. Product Data Sheets: Required for each component that includes: unique identification tag that is
37 consistent throughout the submittal, manufacturer's description, technical data, performance
38 curves, installation/maintenance instructions, and other relevant items. When manufacturer's
39 literature applies to a product series rather than a specific product, the data specifically applicable
40 to the project shall be highlighted or clearly indicated by other means. Each submitted piece of
41 literature and drawings shall clearly reference the specification and/or drawing that the submittal
42 is to cover. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements.
- 43 13. Provide PICS files indicating the BACnet® functionality and configuration of each device.
- 44 14. Provide documentation of submitted products that have been tested and listed by the BACnet
45 Testing Laboratory (BTL), or provide a letter on the manufacturer's company letterhead indicating
46 the anticipated date by which testing is expected to be completed. If, for any reason, BTL testing
47 and listing has not been completed, a written commitment to upgrade installed controls to a version
48 that meets BTL testing and listing requirements in the event that problems are found during BTL
49 testing is required.

- 1 15. Graphic Display: Include a sample graphic of each system and component identified in the points
2 list with a flowchart (site map) indicating how the graphics are to be linked to each other for system
3 navigation.
- 4 16. Software: A list of operating system software, operator interface software, color graphic software,
5 and third-party software.
- 6 17. Control System Demonstration and Acceptance: Provide a description of the proposed process,
7 along with all reports and checklists to be used.
- 8 18. Clearly identify work by others in the submittal.
- 9 19. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to
10 verify.
- 11 C. Operation and Maintenance Manual:
- 12 1. In addition to the requirements of Section 23 05 00, submit an electronic copy of the O&M manuals
13 in PDF format.
- 14 2. Provide three complete sets of manuals.
- 15 3. Each O&M manual shall include:
- 16 a. Table of contents with indexed tabs dividing information as outlined below.
- 17 b. Definitions: List of all abbreviations and technical terms with definitions.
- 18 c. Warranty Contacts: Names, addresses, and 24-hour telephone numbers of contractors
19 installing equipment and controls and service representatives of each.
- 20 d. Licenses, Guarantees, and Warranties: Provide documentation for all equipment and
21 systems.
- 22 e. System Components: Alphabetical list of all system components, with the name, address,
23 and telephone number of the vendor.
- 24 f. Operating Procedures: Include procedures for operating the control systems; logging
25 on/off; enabling, assigning, and reporting alarms; generating reports; collection,
26 displaying, and archiving of trended data; overriding computer control; event scheduling;
27 backing up software and data files; and changing setpoints and other variables.
- 28 g. Programming: Description of the programming language (including syntax), statement
29 descriptions (including algorithms and calculations used), point database creation and
30 modification, program creation and modification, and use of the editor.
- 31 h. Engineering, Installation, and Maintenance: Explain how to design and install new points,
32 panels, and other hardware; recommended preventive maintenance procedures for all
33 system components, including a schedule of tasks (inspection, cleaning, calibration, etc.),
34 time between tasks, and task descriptions; how to debug hardware problems; and how
35 to repair or replace hardware. A list of recommended spare parts.
- 36 i. Original Software: Complete original issue CDs for all software provided, including
37 operating systems, programming language, operator workstation software, and graphics
38 software.

- 1 j. Software: One set of CDs containing an executable copy of all custom software created
2 using the programming language, including the setpoints, tuning parameters, and object
3 database.
- 4 k. Graphics: A glossary or icon symbol library detailing the function of each graphic icon and
5 graphics creation and modification. One set of CDs containing files of all color graphic
6 screens created for the project.
- 7 D. Training Manual:
- 8 1. Provide a course outline and training manuals for each training class.
- 9 E. Record Documents:
- 10 1. Submit record documentation per Section 23 05 00.
- 11 2. Provide a complete set of "as-built" drawings and application software on CDs. Provide drawings
12 as AutoCAD™ or Visio™ compatible files. Provide two copies of the "as-built" drawings with
13 revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall
14 also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF
15 format.
- 16 3. Submit two hard copies and one electronic copy of as-built versions of the shop drawings, including
17 product data and record drawings with revisions clearly indicated. Provide floor plans showing
18 actual locations of control components including panels, thermostats, sensors, and hardware.
- 19 4. Provide all completed testing and commissioning reports and checklists, along with all trend logs
20 for each system identified in the points lists.
- 21 5. Submit printouts of all graphic screens with current values (temperatures, pressures, etc.) to the
22 A/E verifying completion and proper operation of all points.

23 **1.4 DELIVERY, STORAGE AND HANDLING**

- 24 A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through
25 shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials
26 inside and protected from weather.
- 27 B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory
28 mounted on equipment, arrange for shipping control devices to unit manufacturer.

29 **1.5 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION**

- 30 A. Control Valves.
31 B. Flow Switches.
32 C. Temperature Sensor Sockets.
33 D. Gauge Taps.
34 E. Automatic Dampers.
35 F. Flow Meters.
36 G. Variable Frequency Drives - Refer to 23 05 15.

37 **1.6 AGENCY AND CODE APPROVALS**

- 38 A. All products shall have the following agency approvals. Provide verification that the approvals exist for all
39 submitted products with the submittal package.
- 40 1. UL-916; Energy Management Systems.
41 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."

- 1 3. EMC Directive 89/336/EEC (European CE Mark).
2 4. FCC, Part 15, Subpart J, Class A Computing Devices.

3 **1.7 ACRONYMS**

4 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 |

5 **1.8 SUMMARY**

6 A. Provide new standalone FMCS for this project with connection to city server system..

7 B. TCC shall furnish all labor, materials, equipment, and service necessary for a complete and operating
8 Temperature Control System (TCS) and Facility Management and Control System (FMCS) using Direct Digital
9 Controls as shown on the drawings and as described herein.

10 C. All labor, material, equipment and software not specifically referred to herein or on the plans that is required
11 to meet the intent of this specification shall be provided without additional cost to the Owner.

12 D. The Owner shall be the named license holder of all software associated with any and all incremental work on
13 the project.

14 **1.9 LEED REQUIREMENTS**

15 A. This project shall meet the requirements of the U.S. GREEN BUILDING COUNCIL LEADERSHIP IN ENERGY AND
16 ENVIRONMENTAL DESIGN (LEED) program.

17 B. This project will attempt to achieve the U.S. Green Building Council's LEED Version 3.0 certification Level:
18 Silver.

19 C. This Contractor shall carefully examine the LEED portion of this specification for full compliance with the
20 following LEED points:

- 21 1. "Energy & Atmosphere": Prerequisite 1, "Fundamental Building Systems Commissioning,"
22 Prerequisite 2 - "Minimum Energy Performance," Credit 3 - "Additional Commissioning," and Credit
23 5 - "Measurement and Verification," as described by LEED.

- 1 2. “Indoor Environmental Quality”: Prerequisite 1 - “Minimum IAQ Performance,” Credit 1 - “Outdoor
2 Air Delivery Monitoring,” Credit 2 - “Increased Ventilation,” Credit 6 - “Controllability of Systems,”
3 Credit 6.1 - “Lighting Control,” and Credit 6.2 - “Thermal Comfort.”
- 4 3. All labor and materials required for these and any other LEED initiatives shall be provided without
5 additional cost to the Owner.

6 **1.10 SYSTEM DESCRIPTION**

- 7 A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating
8 via the following protocol to an NAC. Temperature Control System products shall be as specified below.
- 9 B. The FMCS shall include Network Area Controller or Controllers (NAC) within each facility. The NAC shall
10 connect to the Owner’s local or wide area network, depending on configuration. Provide access to the
11 system, either locally in each building or remotely from a central site or sites, through standard Web
12 browsers, via the Internet, and/or via local area network.
- 13 C. Provide materials and labor necessary to connect factory supplied control components.
- 14 D. Provide central and remote hardware, software, and interconnecting wire and conduit.
- 15 E. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones
16 and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment
17 and be capable of being programmed by the Owner.
- 18 F. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable
19 Network Management Software. If not, include any software required for controller configuration as a leave-
20 behind tool with enough license capability to support the installation.

21 **1.11 SOFTWARE LICENSE AGREEMENT**

- 22 A. The Owner shall be the named license holder of all software associated with any and all incremental work on
23 the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation,
24 data files, configuration tools, and application-level software developed for the project. This shall include,
25 but is not limited to, all custom, job-specific software code and documentation for all configuration and
26 programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s),
27 and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with
28 all required IDs and passwords for access to any component or software program. The Owner shall determine
29 which organizations shall be named in the SI organization ID (“orgid”) of all software licenses. Owner shall be
30 free to direct the modification of the “orgid” in any software license, regardless of supplier.

31 **1.12 JOB CONDITIONS**

- 32 A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that
33 the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract
34 Documents for possible conflicts between the Work of this section and that of other crafts in equipment
35 location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and
36 architectural features.

37 **1.13 WARRANTY**

- 38 A. Refer to Section 23 05 00 for warranty requirements.
- 39 B. Within the warranty period, any defects in the work provided under this section due to faulty materials,
40 methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired
41 or replaced by this Contractor at no expense to the Owner.

- 1 C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the
2 manufacturer during the one-year warranty period.
- 3 D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived
4 software disks.

5 **1.14 WARRANTY ACCESS**

- 6 A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

7 **PART 2 - PRODUCTS**

8 **2.1 ACCEPTABLE MANUFACTURERS**

Acceptable Manufacturers	BACnet Protocol
Honeywell WEBs-AX	•

9 **2.2 SYSTEM ARCHITECTURE**

- 10 A. General:
- 11 1. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall
12 consist of a network of interoperable, standalone digital controllers, a computer system, graphic
13 user interface software, printers, network devices, valves, dampers, sensors, and other devices as
14 specified herein.
- 15 2. The installed system shall provide secure password access to all features, functions and data
16 contained in the overall FMCS.
- 17 3. The FMCS shall be based on Tridium's Niagara Framework and adhere to the open NICS licensing.
18 The FMCS shall be comprised of Java Application Control Engine or Controllers (JACE) within each
19 facility. The system shall support JACE Version 3.8. The JACE shall connect to the local area network,
20 depending on configuration. Access to the system, either locally in each building, or remotely from
21 a central site or sites, shall be accomplished through standard Web browsers, via the Internet
22 and/or local area network. Each JACE is capable communicate to LonMark/LonTalk (ILC) and/or
23 BACnet (IBC) controllers and other open and legacy protocol systems/devices.
- 24 4. The FMCS shall be based on the NiagaraAX Framework (or "NiagaraAX"), a Java-based framework
25 developed by Tridium. NiagaraAX provides an open automation infrastructure that integrates
26 diverse systems and devices (regardless of manufacturer, communication standard or software)
27 into a unified platform that can be easily managed in real time over the Internet using a standard
28 Web browser. Systems not developed on the NiagaraAX Framework platform are unacceptable.
- 29 5. The entire Temperature Control System (TCS) shall be comprised of a network of interoperable,
30 stand-alone digital controllers communicating via LonMark/LonTalk and/or BACnet communication
31 protocols to Java Application Control Engines (JACE) which communicate BACnet TCP/ IP or OBIX
32 TCP/IP to the Niagara AX Server. Niagara AX Supervisor Software to be installed on owner provided
33 server.
- 34 6. The Owner shall be the named license holder of all software associated with any and all incremental
35 work on the project(s). All Niagara AX software licenses shall have the "accept.station.in=*" and
36 "accept.station.out=*" and "accept.wb.in=*" and "accept.wb.out=*" section of the software
37 licenses. The intent is to ensure that the installed Niagara AX products may be completely open for
38 integrations. Owner shall be free to direct the modification of any software license, regardless of
39 supplier. In addition, the owner shall receive ownership of all job specific software configuration
40 documentation, data files, and application-level software developed for the project. This shall

1 include all custom, job specific software code and documentation for all configuration and
2 programming that is generated for a given project and/or configured for use with Niagara
3 Framework (Niagara AX) based controllers and/or servers and any related LAN / WAN / Intranet
4 and Internet connected routers and devices. Any and all required I.D.'s and passwords for access to
5 any component or software program shall be provided to the owner. Provide all software necessary
6 for developing software algorithms in all supervisory, programmable and application specific direct
7 digital controllers which is licensed to the Owner.

8 B. Open, Interoperable, Integrated Architectures:

9 1. All components and controllers supplied under this Division shall be true "peer-to-peer"
10 communicating devices. Components or controllers requiring "polling" by a host to pass data are
11 not acceptable.

12 2. The supplied system must be able to access all data using standard Web browsers without requiring
13 proprietary operator interface and configuration programs. An Open DataBase Connectivity
14 (ODBC) or Structured Query Language (SQL) compliant server database is required for all system
15 database parameter storage. This data shall reside on a supplier-installed server for all database
16 access. Systems requiring proprietary database and user interface programs are not acceptable.

17 3. Hierarchical or "flat" topologies are required to have system response times as indicated below and
18 to manage the flow and sharing of data without unduly burdening the customer's internal intranet
19 network.

20 a. Maximum acceptable response time from any alarm occurrence (at the point of origin) to
21 the point of annunciation shall not exceed 5 seconds for network connected user
22 interfaces.

23 b. Maximum acceptable response time from any alarm occurrence (at the point of origin) to
24 the point of annunciation shall not exceed 60 seconds for remote or dial-up connected
25 user interfaces.

26 **2.3 NETWORKS**

27 A. The Local Area Network (LAN) shall be a 100 megabits/sec Ethernet network supporting BACnet, Java, XML,
28 HTTP, and SOAP. Provide support for multiple Network Area Controllers (NACs), user workstations and, if
29 specified, a local server.

30 B. Local area network minimum physical and media access requirements:

- 31 1. Ethernet; IEEE Standard 802.3.
32 2. Cable; 100 Base-T, UTP-8 wire, Category 6.
33 3. Minimum throughput; 100 Mbps.

34 C. Communication conduits shall not be installed closer than six feet from 110VAC or higher transformers or run
35 parallel within six feet of electrical high power cables. Route the cable as far from interference generating
36 devices as possible. Where communication wire must cross 110VAC or higher wire, it must do so at right
37 angles.

38 D. Ground all shields (earth ground) at one point only to eliminate ground loops. Provide all shield grounding at
39 the controller location, with the shield at the sensor/device end of the applicable wire being left long and
40 "safed" off in an appropriate manner.

41 E. There shall be no power wiring in excess of 30 VAC rms run in conduit with communications wiring. In cases
42 where signal wiring is run in conduit with communication wiring, run all communication wiring and signal
43 wiring using separate twisted pairs (24awg) in accordance with the manufacturer's wiring practices.

1 **2.4 REMOTE NETWORK ACCESS**

2 A. For Local Area Network installations, provide access to the LAN from a remote location via the Internet. The
3 Owner shall provide a connection to the Internet to enable this access via high speed cable modem,
4 asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or via the customer's intranet to a
5 corporate server providing access to an Internet Service Provider (ISP). Customer agrees to pay monthly
6 access charges for connection and ISP.

7 **2.5 NETWORK AREA CONTROLLER (NAC)**

8 A. The TCC shall supply one or more Network Area Controllers (NAC) as part of this contract. Number of NACs
9 required depends on the type and quantity of devices provided under Divisions 23 and 26. The TCC shall
10 determine the quantity and type of devices.

11 B. Each NAC shall provide the interface between the LAN or WAN and the field control devices and shall provide
12 global supervisory control functions over the control devices connected to the NAC. It shall execute
13 application control programs to provide:

- 14 1. Calendar functions.
- 15 2. Scheduling.
- 16 3. Trending.
- 17 4. Alarm monitoring and routing.
- 18 5. Time synchronization.
- 19 6. Integration of all controller data.
- 20 7. Network Management functions.

21 C. The Network Area Controller shall provide the following hardware features as a minimum:

- 22 1. One Ethernet Port – 10/100 Mbps.
- 23 2. One RS-232 port.
- 24 3. One LonWorks Interface Port – 78KB FTT-10A (for LonWorks systems only).
- 25 4. One RS-485 port.
- 26 5. Battery backup.
- 27 6. Flash memory for long-term data backup. (If battery backup or flash memory is not supplied, the
28 controller shall contain a hard disk with at least 1 gigabyte storage capacity.)
- 29 7. The NAC must be capable of operation over a temperature range of 32°F to 122°F.
- 30 8. The NAC must be capable of withstanding storage temperatures of between 0°F and 158°F.
- 31 9. The NAC must be capable of operation over a humidity range of 5% RH to 95% RH, non-condensing.

32 D. The NAC shall provide multiple user access to the system and support for ODBC or SQL. Databases resident
33 on the NAC shall be ODBC-compliant or must provide an ODBC data access mechanism to read and write data
34 stored within it.

35 E. The NAC shall support standard Web browser access via the Internet or an intranet and a minimum of five (5)
36 simultaneous users.

37 F. Event Alarm Notification and Actions:

38 1. The NAC shall provide alarm recognition, storage; routing, management, and analysis to
39 supplement distributed capabilities of equipment or application specific controllers.

40 2. The NAC shall be able to route any alarm condition to any defined user location whether connected
41 to a LAN, remote via dial-up telephone connection, or WAN.

42 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements
43 including, but not limited to:

44 a. Alarm

- 1 b. Normal
- 2 4. Provide for the creation of a minimum of eight alarm classes with different routing and
- 3 acknowledgement properties, e.g. security, HVAC, Fire, etc.
- 4 5. Provide timed (scheduled) routing of alarms by class, object, group, or node.
- 5 6. Provide alarm generation from binary object "runtime" and/or event counts for equipment
- 6 maintenance. The user shall be able to reset runtime or event count values with appropriate
- 7 password control.
- 8 G. Treat control equipment and network failures as alarms and annunciated.
- 9 H. Annunciate alarms in any of the following manners as defined by the user:
- 10 1. Screen message text.
- 11 2. E-mail of the complete alarm message to multiple recipients. Provide the ability to route and e-
- 12 mail alarms based on:
- 13 a. Day of week.
- 14 b. Time of day.
- 15 c. Recipient.
- 16 3. Pagers via paging services that initiate a page on receipt of e-mail message.
- 17 4. Graphic with flashing alarm object(s).
- 18 5. Printed message, routed directly to a dedicated alarm printer.
- 19 I. The FMCS shall record the following for each alarm:
- 20 1. Time and date.
- 21 2. Location (building, floor, zone, office number, etc.).
- 22 3. Equipment tag.
- 23 4. Acknowledge time, date, and user who issued acknowledgement.
- 24 5. Number of occurrences since last acknowledgement.
- 25 J. Give defined users proper access to acknowledge any alarm.
- 26 K. A log of all alarms shall be maintained by the NAC and/or a server (if configured in the system) and shall be
- 27 available for review by the user.
- 28 L. Provide a "query" feature to allow review of specific alarms by user-defined parameters.
- 29 M. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for
- 30 review by the user.
- 31 N. An error log to record invalid property changes or commands shall be provided and available for review by
- 32 the user.
- 33 **2.6 BACNET FMCS**
- 34 A. The intent of this specification is to provide a peer-to-peer networked, standalone, distributed control system
- 35 with the capability to integrate ANSI/ASHRAE Standard 135-2001 BACnet, MODBUS, OPC, and other open and
- 36 proprietary communication protocols in one open, interoperable system.

- 1 B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data
2 and control devices in the system. Adherence to industry standards including the latest ANSI/ASHRAE
3 Standard 135 (BACnet) to assure interoperability between all system components is required. For each
4 BACnet device, the device supplier must provide a PICS document showing the installed device's compliance
5 level. Minimum compliance is Level 3; with the ability to support data read and write functionality. Physical
6 connection of BACnet devices shall be via Ethernet (BACnet Ethernet/IP) and/or RS-485 (BACnet MSTP).
- 7 C. Interoperable BACnet Controller (IBC):
- 8 1. Controls shall be microprocessor based Interoperable BACnet Controllers (IBC) in accordance with
9 the latest ANSI/ASHRAE Standard 135. Provide IBCs for unit ventilators, fan coils, heat pumps,
10 terminal air boxes (TAB) and other applications. The application control program shall reside in the
11 same enclosure as the input/output circuitry that translates the sensor signals. Provide a PICS
12 document showing the installed system's compliance level to ANSI/ASHRAE Standard 135.
13 Minimum compliance is Level 3.
- 14 2. The IBCs shall be listed by the BACnet Testing Laboratory (BTL) as follows:
- 15 a. BACnet Building Controller(s) (B-BC).
16 b. BACnet Advanced Application Controller(s) (B-ACC).
17 c. BACnet Application Specific Controller(s) (B-ASC).
- 18 3. The IBCs shall communicate with the NAC via an Ethernet connection at a baud rate of not less than
19 10 Mbps.
- 20 4. Each IBC sensor shall connect directly to the IBC and shall not use any of the I/O points of the
21 controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and
22 wire type insensitive. The IBC sensor shall provide a communications jack for connection to the
23 BACnet communication trunk to which the IBC controller is connected. The IBC sensor, the
24 connected controller, and all other devices on the BACnet bus shall be accessible by the POT.
- 25 5. All IBCs shall be fully application programmable and shall at all times maintain their BACnet Level 3
26 compliance. Controllers offering application selection only (non-programmable) require a 10%
27 spare point capacity to be provided for all applications. Store all control sequences within or
28 programmed into the IBC in non-volatile memory that does not depend on a battery to be retained.
- 29 6. The Contractor supplying the IBCs shall provide documentation for each device, with the following
30 information at a minimum:
- 31 a. BACnet Device; MAC address, name, type and instance number.
32 b. BACnet Objects; name, type and instance number.
- 33 7. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in
34 each IBC.
- 35 D. Object Libraries
- 36 1. A standard library of objects shall be included for development and setup of application logic, user
37 interface displays, system services, and communication networks.
- 38 2. The objects in this library shall be capable of being copied and pasted into the user's database and
39 shall be organized according to their function. In addition, the user shall have the capability to
40 group objects created in their application and store the new instances of these objects in a user-
41 defined library.
- 42 3. In addition to the standard libraries specified here, the system supplier shall maintain an on-line
43 accessible (over the Internet) library, available to all registered users, to provide new or updated
44 objects and applications as they are developed.

- 1 4. All control objects shall conform to the control objects specified in the BACnet specification.
- 2 5. The library shall include applications or objects for the following functions, at a minimum:
- 3 a. Scheduling Object: The schedule must conform to the schedule object as defined in the
4 BACnet specification, providing seven-day plus holiday and temporary scheduling
5 features and a minimum of 10 on/off events per day. Data entry to be by graphic sliders
6 to speed creation and selection of on-off events.
- 7 b. Calendar Object: The calendar must conform to the calendar object as defined in the
8 BACnet specification, providing 12-month calendar features to allow for holiday or special
9 event data entry. Data entry to be by graphic "point-and-click" selection. This object must
10 be "linkable" to any or all scheduling objects for effective event control.
- 11 c. Override Object: Provide override object that is capable of restarting equipment turned
12 off by other energy saving programs to maintain occupant comfort or for equipment
13 protection.
- 14 d. Start-Stop Time Optimization Object: Provide a start-stop time optimization object to
15 start equipment just early enough to bring space conditions to desired conditions by the
16 scheduled occupancy time. Also, allow equipment to be stopped before the scheduled
17 unoccupied time just far enough ahead to take advantage of the building's "flywheel"
18 effect for energy savings. Provide automatic tuning of all start-stop time object properties
19 based on historical performance.
- 20 e. Demand Limiting Object: Provide a demand-limiting object that is capable of controlling
21 demand for any selected energy utility (electric, oil, gas, etc.). The object shall be able to
22 monitor a demand value and predict (using a sliding window prediction algorithm) the
23 demand at the end of the user-defined interval period (1 to 60 minutes). This object shall
24 also accommodate a utility meter time sync pulse for fixed interval demand control. Upon
25 a prediction that will exceed the user-defined demand limit (supply a minimum of 6 per
26 day), the demand limiting object shall issue shed commands to either turn off user
27 specified loads or modify equipment setpoints to provide the desired energy reduction.
28 If the list of sheddable equipment is not enough to reduce the demand to below the
29 setpoint, display a message on the user's screen (as an alarm) instructing the user to take
30 manual actions to maintain the desired demand. The shed lists are specified by the user
31 and shall be selectable to be shed in either a fixed or rotating order to control which
32 equipment is shed the most often. Upon suitable reductions in demand, the demand-
33 limiting object shall restore the equipment that was shed in the reverse order in which it
34 was shed. Each sheddable object shall have a minimum and maximum shed time property
35 to provide both equipment protection and occupant comfort.
- 36 6. The library shall include control objects for the following functions:
- 37 a. Analog Input Object: Minimum requirement is to comply with the BACnet standard for
38 data sharing. Allow high, low and failure limits to be assigned for alarming. Also, provide
39 a time delay filter property to prevent nuisance alarms caused by temporary excursions
40 above or below the user defined alarm limits.
- 41 b. Analog Output Object: Minimum requirement is to comply with the BACnet standard for
42 data sharing.
- 43 c. Binary Input Object: Minimum requirement is to comply with the BACnet standard for
44 data sharing. The user must be able to specify either input condition for alarming. This
45 object must also include the capability to record equipment runtime by counting the
46 amount of time the hardware input is in an "on" condition. The user must be able to
47 specify either input condition as the "on" condition.

- 1 d. Binary Output Object: Minimum requirement is to comply with the BACnet standard for
2 data sharing. Properties to enable minimum on and off times for equipment protection
3 as well as start-to-start delay must be provided. Incorporate the BACnet Command
4 Prioritization priority scheme to allow multiple control applications to execute commands
5 on this object with the highest priority command being invoked. Provide 16 levels of
6 priority as a minimum. Systems not employing the BACnet method of contention
7 resolution are not acceptable.
- 8 e. PID Control Loop Object: Minimum requirement is to comply with the BACnet standard
9 for data sharing. Each individual property must be adjustable to allow proportional
10 control only, or proportional with integral control, or proportional, integral and derivative
11 control.
- 12 f. Comparison Object: Allow a minimum of two analog objects to be compared to select
13 either the highest, lowest, or equality between the two linked inputs. Also, allow limits to
14 be applied to the output value for alarm generation.
- 15 g. Math Object: Allow a minimum of four analog objects to be tested for the minimum or
16 maximum, or the sum, difference, or average of linked objects. Also, allow limits to be
17 applied to the output value for alarm generation.
- 18 h. Custom Programming Objects: Provide a blank object template for the creation of new
19 custom objects to meet specific user application requirements. This object must provide
20 a simple BASIC-like programming language that is used to define object behavior. Provide
21 a library of functions including, but not limited to, math and logic functions and string
22 manipulation. Also, provide a comprehensive on-line debug tool to allow complete
23 testing of the new object. Allow new objects to be stored in the library for reuse.
- 24 i. Interlock Object: Provide an interlock object that provides a means of coordination of
25 objects within a piece of equipment, such as an air handler or other similar types of
26 equipment. An example is to link the return fan to the supply fan such that, when the
27 supply fan is started, the return fan object is also started automatically without the user
28 having to issue separate commands or to link each object to a schedule object. In
29 addition, the control loops, damper objects, and alarm monitoring (such as return air,
30 supply air, and mixed air temperature objects) will be inhibited from alarming during a
31 user-defined period after startup to allow for stabilization. When the air handler is
32 stopped, the interlocked return fan is also stopped, the outside air damper is closed, and
33 other related objects within the air handler unit are inhibited from alarming, thereby
34 eliminating nuisance alarms during the off period.
- 35 j. Temperature Override Object: Provide an object whose purpose is to override a binary
36 output to an "on" state in the event a user-specified high or low limit value is exceeded.
37 Link this object to the desired binary output object as well as to an analog object for
38 temperature monitoring to cause the override to be enabled. This object will execute a
39 start command at the Temperature Override level of start/stop command priority, unless
40 changed by the user.
- 41 k. Composite Object: Provide a container object that allows a collection of objects
42 representing an application to be encapsulated to protect the application from tampering
43 or to more easily represent large applications. This object must have the ability to allow
44 the user to select the appropriate parameters of the "contained" application that are
45 represented on the graphic shell of this container.
- 46 7. The object library shall include objects to support the integration of devices connected to the
47 Network Area Controller (NAC). Provide the following as part of the standard library included with
48 the programming software:

- 1 a. For BACnet devices, provide the following objects:
- 2 1) Analog In.
 - 3 2) Analog Out.
 - 4 3) Analog Value.
 - 5 4) Binary.
 - 6 5) Binary In.
 - 7 6) Binary Out.
 - 8 7) Binary Value.
 - 9 8) Multi-State In.
 - 10 9) Multi-State Out.
 - 11 10) Multi-State Value.
 - 12 11) Schedule Export.
 - 13 12) Calendar Export.
 - 14 13) Trend Export.
 - 15 14) Device.
- 16 b. For each BACnet object, provide the ability to assign the object a BACnet device and
17 object instance number.
- 18 c. For BACnet devices, provide the following support at a minimum:
- 19 1) Segmentation.
 - 20 2) Segmented Request.
 - 21 3) Segmented Response.
 - 22 4) Application Services.
 - 23 5) Read Property.
 - 24 6) Read Property Multiple.
 - 25 7) Write Property.
 - 26 8) Write Property Multiple.
 - 27 9) Confirmed Event Notification.
 - 28 10) Unconfirmed Event Notification.
 - 29 11) Acknowledge Alarm.
 - 30 12) Get Alarm Summary.
 - 31 13) Who-has.
 - 32 14) I-have.
 - 33 15) Who-is.
 - 34 16) I-am.
 - 35 17) Subscribe COV.
 - 36 18) Confirmed COV notification.
 - 37 19) Unconfirmed COV notification.
 - 38 20) Media Types.
 - 39 21) Ethernet.
 - 40 22) BACnet IP Annex J.
 - 41 23) MSTP.
 - 42 24) BACnet Broadcast Management Device (BBMD) function.
 - 43 25) Routing.

44 **2.7 TERMINAL AIR BOX (TAB) CONTROLLERS**

- 45 A. FMCS Volume Controller: Electronic, furnished and installed by TCC. Boxes shall have pressure independent
46 control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide
47 velocity and static sensor at box inlet for use by unit controller. Set boxes for maximum and minimum settings
48 shown on the drawings. Refer to Section 23 36 00 for additional information.
- 49 B. The controller shall support various digital and analog inputs and outputs as needed for damper control,
50 control valves, electric coils, airflow sensors, remote heating, occupancy sensors, etc. and shall be capable of
51 independent occupancy scheduling.

- 1 C. Controller shall provide continuous zone temperature histories internal to device for up to 24 hours and
2 perform its own limit and status monitoring and alarms to limit unnecessary communications.
- 3 D. Operator interface to any ASC point data or programs shall be through network resident programs or portable
4 operator's terminal connected to the specific controller.
- 5 E. Store all system setpoints, proportional bands, control algorithms, and other programmable parameters such
6 that a power failure of any duration does not necessitate reprogramming of the controller.
- 7 F. BACnet TAB controllers shall either be B-AAC devices or B-ASC devices as required to meet the performance
8 and BTL listing.

9 **2.8 DATA COLLECTION AND STORAGE (TRENDING REQUIREMENTS)**

- 10 A. The NAC shall be able to collect data for any property of any object and store resident in the NAC that shall
11 have, at a minimum, the following configurable properties:
- 12 1. Designating the log as interval or deviation.
- 13 2. For interval logs, configure the object for time of day, day of week and the sample collection
14 interval.
- 15 3. For deviation logs, configure the object for the deviation of a variable to a fixed value. This value,
16 when reached, will initiate logging of the object.
- 17 4. For all logs, provide the ability to set the maximum number of data stores for the log and to set
18 whether the log will stop collecting when full or rollover the data on a first-in, first-out basis.
- 19 5. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined
20 event or action.
- 21 B. Store all log data in a relational database in the NAC that is accessible from a server (if the system is so
22 configured) or a standard Web browser.
- 23 C. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL
24 statements.
- 25 D. All log data shall be available to the user in ALL the following data formats:
- 26 1. HTML.
- 27 2. XML.
- 28 3. Plain text.
- 29 4. Comma or tab separated values.
- 30 E. The NAC shall archive its log data either locally (to itself) or remotely to a server or other NAC on the network.
31 Provide the ability to configure the following archiving properties:
- 32 1. Archive on time of day.
- 33 2. Archive on user-defined number of data stores in the log (buffer size).
- 34 3. Archive when log has reached its user-defined capacity of data stores.
- 35 4. Provide ability to clear logs once archived.

1 F. Coordinate with city on what information that want trended for LEED Measurement and Verification
2 Purposes.

3 **2.9 AUDIT LOG**

4 A. Provide and maintain an audit log that tracks all activities performed on the NAC. Provide the ability to specify
5 a buffer size for the log and the ability to archive log based on time or when the log has reached its user-
6 defined buffer size. Provide the ability to archive the log locally (to the NAC), to another NAC on the network,
7 or to a server. For each log entry, provide the following data:

- 8 1. Time and date.
- 9 2. User ID.
- 10 3. Change or activity: i.e., change setpoint, add or delete objects, commands, etc.

11 **2.10 DATABASE BACKUP AND STORAGE**

12 A. The NAC shall automatically backup its database on a user-defined time interval.

13 B. Store copies of the current database and, at the most, the recently saved database in the NAC. The age of
14 the most recently saved database shall depend on the user-defined database save interval.

15 C. Store the NAC database in XML format to allow viewing and editing. Other formats are acceptable as long as
16 XML format is supported.

17 **2.11 GRAPHIC USER INTERFACE SOFTWARE**

18 A. Operating System:

19 1. Provide computer with the most current Microsoft-based operating system with which the GUI has
20 proven compatibility.

21 B. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to
22 Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition,
23 menu pulldowns and toolbars shall employ buttons, commands and navigation to permit the operator to
24 perform tasks with basic computing skills. These shall include, but are not limited to, forward/backward
25 buttons, home button, and a context sensitive locator line (similar to a URL line) that displays the location
26 and the selected object identification.

27 C. Point Organization: Organize points by equipment categories, location, or other means acceptable to Owner.

28 D. Real-Time Displays: The GUI shall support the following graphic features and functions:

29 1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP,
30 or JPG file. Use of proprietary graphic file formats is not acceptable. In addition to, or in lieu of, a
31 graphic background, the GUI shall support the use of scanned pictures.

32 2. Graphic screens shall be able to contain objects for text, real-time values, animation, color spectrum
33 objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URLs, and
34 links to other graphic screens.

35 3. Graphics shall support layering, and each graphic object shall be configurable for assignment to a
36 layer. A minimum of six layers shall be supported.

37 4. Modifying common application objects, such as schedules, calendars, and setpoints, shall be
38 accomplished graphically.

39 a. Schedule times shall be adjusted using a graphic slider without requiring any keyboard
40 entry from the operator.

- 1 b. Holidays shall be set by using a graphic calendar without requiring any keyboard entry
2 from the operator.
 - 3 5. Commands to start and stop binary objects shall be made by selecting the object and the
4 appropriate command from a pop-up menu. No text entry shall be required.
 - 5 6. Adjustments to analog objects, such as setpoints, shall be made by selecting the object and using a
6 graphic slider to adjust the value. No text entry shall be required.
 - 7 E. System Configuration: At a minimum, the GUI shall include the necessary software and components to enable
8 the operator to perform the following tasks with proper password access:
 - 9 1. Create, delete or modify control strategies.
 - 10 2. Add/delete objects.
 - 11 3. Tune control loops by adjusting control loop parameters.
 - 12 4. Enable or disable control strategies.
 - 13 5. Generate hard copy records or control strategies on a printer.
 - 14 6. Select alarm points and define the alarm state.
 - 15 7. Select points to be trended and initiate the recording of values automatically.
 - 16 8. View any trend as a graph.
 - 17 F. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing
18 of the system. On-line help shall be available for all applications and shall provide the relevant data for that
19 particular screen. Additional help information shall be available through the use of hypertext. All system
20 documentation and help files shall be in HTML format.
 - 21 G. Security: Each operator shall be required to log on to that system with a user name and password in order to
22 view, edit, add, or delete data. System security shall be selectable for each operator. The system
23 administrator shall be able to set passwords and security levels for all other operators. Each operator
24 password shall be able to restrict the operator's access for viewing and/or changing each system application,
25 full screen editor, and object. Each operator shall be automatically logged off the system if no keyboard or
26 mouse activity is detected. This auto log-off time shall be set per operator password. Store all system security
27 data in an encrypted format.
 - 28 H. System Diagnostics: The system shall automatically monitor the operation of all workstations, printers,
29 modems, network connections, building management panels, and controllers. Annunciate the failure of any
30 device to the operator.
 - 31 I. Alarm Console:
 - 32 1. The system shall have a dedicated alarm window or console. This window will notify the operator
33 of an alarm condition, and allow the operator to view details of the alarm and to acknowledge the
34 alarm.
 - 35 2. When the alarm console is enabled, a separate alarm notification window will supersede all other
36 windows on the desktop and shall not be capable of being minimized or closed by the operator.
37 This window will notify the operator of new alarms and un-acknowledged alarms. Alarm
38 notification windows or banners that can be minimized or closed by the operator are not
39 acceptable. The use of the alarm console can be enabled or disabled by the system administrator.
- 40 **2.12 WEB BROWSER CLIENTS**
- 41 A. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such
42 as Internet Explorer™, Firefox™, or Chrome. Systems requiring additional software to enable a standard Web
43 browser to reside on the client machine, or manufacturer-specific browsers, are not acceptable.
 - 44 B. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs,
45 etc., and provide the same interface methodology as is provided by the Graphic User Interface. Systems that

- 1 require different views or that require different means of interacting with objects, such as schedules or logs,
2 are not permitted.
- 3 C. The Web browser client shall provide:
- 4 1. User log-on identification and password shall be required. If an unauthorized user attempts access,
5 display a blank web page. Implement security using Java authentication and encryption techniques
6 to prevent unauthorized access.
- 7 2. Graphic screens developed for the GUI shall be the same screens used for the Web browser client.
8 The web browser interface shall support all animated graphic objects supported by the GUI.
- 9 3. HTML programming shall not be required to display system graphics or data on a Web page. HTML
10 editing of the Web page shall be allowed if the user desires a specific look or format.
- 11 4. Store all graphic screens in the Network Area Controller (NAC) without requiring any graphics
12 storage on the client machine.
- 13 5. Real-time values displayed on a Web page shall update automatically without requiring a manual
14 "refresh" of the Web page.
- 15 6. Users shall have administrator-defined access privileges. Depending on the access privileges
16 assigned, the user shall be able to perform the following:
- 17 a. Modify common application objects, such as schedules, calendars, and setpoints,
18 graphically.
- 19 1) Schedule times shall be adjustable using a graphic slider, without requiring any
20 keyboard entry from the operator.
- 21 2) Holidays shall be set using a graphic calendar, without requiring any keyboard
22 entry from the operator.
- 23 b. Commands to start and stop binary objects shall be made by right-clicking the selected
24 object and selecting the appropriate command from a pop-up menu. No text entry shall
25 be required.
- 26 c. View logs and charts.
- 27 d. View and acknowledge alarms.
- 28 e. Setup and execute SQL queries on log and archive information
- 29 7. The system shall be able to specify a user's (as determined by the log-on user identification) home
30 page. Provide the ability to limit a specific user to just his/her defined home page. From the home
31 page, links to other views or pages in the system shall be possible, if allowed by the system
32 administrator.
- 33 8. Graphic screens on the Web Browser client shall support hypertext links to other locations on the
34 Internet or on intranet sites by specifying the Uniform Resource Locator (URL) for the desired link.
- 35 **2.13 UNINTERRUPTIBLE POWER SUPPLY (UPS)**
- 36 A. A UPS shall be provided for each of the following:
- 37 1. FMCS workstations and servers.
38 2. Network area controllers.

- 1 3. Chiller plant manager.
- 2 4. Boiler plant manager.

- 3 B. Provide a 120 volt 60 Hz line-interactive uninterruptible power supply with backup battery capacity for 5
- 4 minutes at 100% load. UPS shall have hot swappable batteries, automatic battery self-test and start-on-
- 5 battery capabilities. Batteries shall be valve regulated, sealed lead acid type. UPS shall have sine wave shape
- 6 output waveform. UPS shall be UL 1778 list and comply with FCC Part 15, Class A.

- 7 C. Acceptable Manufacturers: Sola/Hevi-Duty, Eaton Powerware, APC.

8 **2.14 SYSTEM PROGRAMMING**

- 9 A. The GUI software shall perform system programming and graphic display engineering. Access to the GUI
- 10 software shall be through password access as assigned by the system administrator.

- 11 B. Provide a library of control, application, and graphic objects to enable creation of all applications and user
- 12 interface screens. Applications shall be created by selecting the control objects from the library, dragging or
- 13 pasting them on the screen, and linking them together using a built-in graphic connection tool. Completed
- 14 applications may be stored in the library for future use. GUI screens shall be created in the same fashion.
- 15 Data for the user displays shall be obtained by graphically linking the user display objects to the application
- 16 objects to provide "real-time" data updates. Any real-time data value or object property may be connected
- 17 to display its current value on a user display. Provide all software tools or processes to create applications
- 18 and user interface displays.

- 19 C. Programming Methods

- 20 1. Provide the capability to copy objects from the supplied libraries or from a user-defined library to
- 21 the user's application. Link objects with a graphic linking scheme by dragging a link from one object
- 22 to another. Object links will support one-to-one, many-to-one, or one-to-many relationships.
- 23 Linked objects shall maintain their connections to other objects regardless of where they are
- 24 positioned on the page and shall show link identification for links to objects on other pages for easy
- 25 identification. Links will vary in color depending on the type of link; e.g., internal, external,
- 26 hardware, etc.

- 27 2. Configuration of each object shall be done through the object's property sheet using fill-in-the-
- 28 blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or
- 29 a manufacturer-specific procedural language for configuration is not acceptable.

- 30 3. The software shall provide the ability to view the logic in a monitor mode. When on-line, the
- 31 monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic
- 32 execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and
- 33 monitor the logic for diagnosing execution before it is applied to the system.

- 34 4. All programming shall be done in real time. Systems requiring the uploading, editing, and
- 35 downloading of database objects are not allowed.

- 36 5. The system shall support object duplication in a customer's database. An application, once
- 37 configured, can be copied and pasted for easy reuse and duplication. All links, other than to the
- 38 hardware, shall be maintained during duplication.

39 **2.15 DDE DEVICE INTEGRATION**

- 40 A. The NAC shall support the integration of device data via Dynamic Data Exchange (DDE) over the Ethernet
- 41 network. The NAC shall act as a DDE client to another software application that functions as a DDE server.

- 1 B. Provide the required objects in the library included with the Graphic User Interface programming software to
2 support the integration of these devices into the FMCS. Objects provided shall include, at a minimum:
- 3 1. DDE Generic AI Object.
4 2. DDE Generic AO Object.
5 3. DDE Generic BO Object.
6 4. DDE Generic BI Object.
- 7 **2.16 SOFTWARE**
- 8 A. IDC/IBCs shall operate totally standalone and independent of a central computer for all specified control
9 applications.
- 10 B. Software shall include a complete operating system (OS), communications handler, point processing, energy
11 management application packages as specified herein, standard control algorithms and specific control
12 sequences (IDC/IBC) and an Owner/user custom control calculation package complete with interpreter.
- 13 C. OS software shall be PROM resident, operate in real time, provide prioritized task scheduling, control time
14 programs, monitor and manage communications, and scan inputs and outputs.
- 15 D. Each IDC/IBC panel shall include the following energy management routines:
- 16 1. Time of day scheduling.
17 2. Optimum start/stop.
18 3. Peak demand limiting.
19 4. Economizer control.
20 5. PID control.
21 6. Supply air reset.
22 7. Outdoor air reset.
- 23 E. Input/output point processing software shall include:
- 24 1. Update of all connected input and output points at least once per second.
- 25 2. Analog to digital conversion, scaling and offset, correction of sensor non-linearity, sensing no
26 response or failed sensors, and conversion of values to 32-bit floating point format. Retain both
27 the maximum and minimum values sensed for each analog input in memory. It shall be possible to
28 input subsets of standard sensor ranges to the A/D converter and assign gains to match the full-
29 scale 32-bit conversion to achieve high accuracy readout.
- 30 3. A reasonability check on all analog inputs against previous values and discarding of values falling
31 outside preprogrammed reasonability limits.
- 32 4. Assignment of proper engineering units and status conditions to all inputs and outputs.
- 33 5. Analog input alarm comparison with the ability to assign two individual sets of high and low limits
34 (warning and alarm) to an input or to assign a set of floating limits (alarm a reset schedule or FMCS
35 control point) to the input. Assign each alarm a unique differential to prevent a point from
36 oscillating in and out of alarm. Make alarm comparisons of each scan cycle.
- 37 6. Adjustment of timing from two seconds to two minutes in one-second increments to eliminate
38 nuisance alarms on startup.
- 39 F. Command Control software shall manage the receipt of commands from the server and from control
40 programs.
- 41 1. Provide command delay to prevent simultaneous energizing of loads. Delay must be programmable
42 from 0 to 30 seconds.

- 1 2. Assign each command a command and residual priority to manage conflicts created by multiple
2 programs having access to the same command point. Allow only outputs with a higher command
3 priority to execute. Whenever a command is allowed to execute, its assigned residual priority shall
4 replace the existing residual priority.
- 5 3. A "fixed mode" option (override) shall allow inputs to and outputs from control programs to set to
6 a fixed state or value. When in the "fixed mode", assign inputs and outputs high residual command
7 priority to prevent override by application programs.
- 8 G. Alarm lockout software shall prevent nuisance alarms. On initial start-up of mechanical equipment, assign a
9 "timed lockout" period to analog points to allow them to reach a stable condition before activating alarm
10 comparison logic. Lockout period shall be programmable for each point from 0 to 90 minutes in one-minute
11 increments.
- 12 H. A "hard lockout" shall also be provided to positively lock out alarms when equipment is turned off or when a
13 true alarm depends on the condition of an associated point. Hard lockout points and lockout initiators shall
14 be operator programmable.
- 15 I. Runtime shall be accumulated based on the status of a digital input point. It shall be possible to totalize either
16 on time or off time up to 10,000 hours with one-minute resolution. Runtime counts shall reside in non-volatile
17 memory and have DCP resident runtime limits assignable through the operator's terminal.
- 18 J. A transition counter shall count the number of times a device is cycled on or off. Counter shall be non-volatile
19 and capable of counting 600,000 cycles. Limits shall be assignable to counts to provide maintenance alarm
20 printouts.
- 21 K. Custom IDC/IBC programs shall meet the control strategies called for in the sequence of operation of these
22 specifications. Each IDC/IBC shall have resident in its memory and available to the programs a full library of
23 IDC/IBC algorithms, intrinsic control operators, arithmetic, logic, and relational operators. Provide the
24 following features:
- 25 1. Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID),
26 and Adaptive Control (self-learning). Use Adaptive Control where the controlled flow rate is
27 variable (such as TAB units and variable flow pumping loops). The adaptive control algorithm shall
28 monitor the loop response to output corrections and adjust the loop response characteristics in
29 accordance with the time constant changes imposed by variable flow rates. The algorithm shall
30 operate in a continuous self-learning manner and shall retain in memory a stored record of the
31 system dynamics so that, on system shutdown and restart, the learning process starts from where
32 it left off. Standard PID algorithms are not acceptable substitutes for variable flow applications
33 since they will provide satisfactory control at only one flow rate and will require continued manual
34 fine tuning.
- 35 2. All IDC/IBC setpoints, gains and time constants associated with IDC/IBC programs shall be available
36 to the operator for display and modification via the operator workstation.
- 37 3. The execution interval of each IDC/IBC loop shall be adjustable from 2 to 120 seconds in one-second
38 increments.
- 39 4. IDC/IBC control programs shall assign initialization values to all outputs so controlled devices
40 assume a failsafe position on start-up.
- 41 L. Provide time and event programming (TEP) capability to initiate a controlled sequence of events for execution
42 at a specific time or upon the occurrence of an event. Minimum program features required are:
- 43 1. Analog points commandable to a specific value.
- 44 2. Digital points commandable to a specific state; e.g. on or off; fast, slow or off.

- 1 3. Initiator to be a specific day and time or a specific event; e.g. an alarm.
- 2 4. Manual initiation via operator's command.
- 3 5. Commands must honor command delays (to prevent current surges), and assigned minimum ON
4 and OFF times.
- 5 6. Commands must honor command and residual priority structures allowing higher priority
6 commands (like smoke control) to override lower priority commands (like time of day scheduling)
7 and residual priority.
- 8 7. Ability to chain TEPs.
- 9 8. Ability to enable and disable TEPs individually.
- 10 9. Ability to enable/disable TEP initiators.
- 11 M. Store Energy Management application programs and associated data files in non-volatile or 72-hour battery
12 backed RAM memory. Individual programs shall be accessible from the operator workstation for
13 enabling/disabling and program parameter modification and shall include:
 - 14 1. Time Programs:
 - 15 a. Provide an independent start and stop program time for each system identified in the
16 points list.
 - 17 b. It shall be possible to assign two independent start and stop times/days to any equipment
18 connected to a controller.
 - 19 2. Exception Day Scheduling:
 - 20 a. Provide an Exception Day program for holiday and other planned exceptions to time
21 programs. Exception schedules shall be DSC resident and operator programmable up to
22 one year in advance.
 - 23 b. The program shall allow definition of up to 32 exception time spans. Define each span by
24 calendar start day and calendar stop day.
 - 25 3. An IDC/IBC resident temporary scheduler shall allow operators to modify present time program
26 control of equipment. Minimum feature set required is:
 - 27 a. Ability to alter time schedules as much as six days in advance.
 - 28 b. Ability to alter either start time, stop time or both for each day.
 - 29 c. Temporary schedule shall be in effect for all days specified.
 - 30 d. Automatically delete the temporary schedule and restore program to normal schedule
31 after execution.
 - 32 e. Ability to assign schedule changes as permanent as well as temporary.
- 33 N. The IDC/IBC shall have built-in, non-descriptive, self-test procedure for checking the indication lights, digital
34 display, and memory. It shall display advisories for maintenance, performance, and/or software problems.

1 O. All electronics shall be:

- 2 1. Standard locally stocked modular boards.
- 3 2. Plug-in type.
- 4 3. Furnish all ROM programs unlocked.

5 **2.17 CONTROL DAMPERS**

6 A. Rectangular Control Dampers - Standard Construction:

7 1. Shall be licensed to bear the AMCA Certified Rating Seal.

8 2. Test leakage and pressure drop per AMCA 500.

9 3. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk
10 or weld seams to prevent leakage.

11 4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping
12 blades and blade seals (overlapping blade seals only is unacceptable).

13 5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft
14 shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator.
15 Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as
16 required.

17 6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a
18 polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper
19 applications.

20 7. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.

21 8. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot
22 within the frame.

23 9. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc
24 plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted
25 otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper
26 section. Jack-shafting is not acceptable.

27 10. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total
28 cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of
29 blank-off sections.

30 11. Damper shall be maintenance free Leakage Class 1A.

31 12. Maximum Pressure Drop for Opposed Blade Damper: 0.15" for 8,000 cfm through a 24"x24"
32 damper (2000 fpm).

33 13. Maximum Pressure Drop for Parallel Blade Damper: 0.08" for 8,000 cfm through a 24"x24" damper
34 (2000 fpm).

35 B. Thermally Insulated Control Damper:

36 1. Shall be licensed to bear the AMCA Certified Rating Seal.

37 2. Test leakage and pressure drop per AMCA 500.

- 1 3. Frame: Extruded aluminum, minimum 4" deep, 0.080" minimum thickness. Frame shall be
2 insulated with Styrofoam on three sides if installed in duct and four sides if flanged to duct.
- 3 4. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, internally
4 insulated with expanded polyurethane foam and thermally broken, with overlapping blades and
5 blade seals (overlapping blade seals only is unacceptable).
- 6 5. Shaft: Non-cylindrical, solid aluminum shaft with opening in blade to match profile of shaft. Shaft
7 shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator.
8 Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as
9 required.
- 10 6. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a
11 polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper
12 applications.
- 13 7. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot
14 within the frame.
- 15 8. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc
16 plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted
17 otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper
18 section. Jack-shafting is not acceptable.
- 19 9. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total
20 cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of
21 blank-off sections.
- 22 10. Damper shall be rated for conditions of -40°F.
- 23 11. Maximum Leakage: Damper shall be maintenance free Leakage Class 1A.
- 24 12. Maximum Pressure Drop: 0.21" for 8,000 cfm through a 24"x24" damper (2000 fpm).

25 **2.18 DAMPER ACTUATORS**

- 26 A. Damper Actuators - Electronic - Spring Return:
- 27 1. Damper actuators shall be UL listed, electronic direct coupled with spring return to normal position
28 for modulating or two-position control as noted in the sequence of control. Actuator shall be 24
29 VAC with proportional control, electronic overload protection to prevent actuator damage due to
30 over-rotation and "V" bolt clamp with matching "V" toothed cradle (single bolt or setscrew
31 fasteners not acceptable).
- 32 2. Following power interruption, spring return mechanism shall close the damper. Mechanical spring
33 shall be rated for a minimum of 60,000 full cycles. Provide breathable membrane in actuator
34 housing to compensate for pressure differential and allow for 95% non-condensing relative
35 humidity in the airstream.
- 36 3. Mount actuators with motor outside of airstream whenever possible. Unit casings shall have
37 housing with proper weather, corrosive, or explosion-proof construction as required by application.
- 38 4. Actuators shall be rated for 60,000 full cycles at rated torque with 2-year unconditional warranty.
39 Size actuators per damper manufacturer's recommendations.
- 40 5. Provide end switches as required for the sequence of operation.
- 41 6. Provide analog feedback signal for positive position indication. Refer to FMCS points list.

- 1 7. Acceptable manufacturer: Honeywell or Belimo
- 2 **2.19 HYDRONIC CONTROL VALVES**
- 3 A. General:
- 4 1. All control valves shall be pressure independent type control valves.
- 5 2. Two-position valves shall be a minimum of line size with a maximum allowable pressure drop of 2
- 6 psi.
- 7 3. Size two-way and three-way modulating valves to provide a pressure drop at full flow of 1 to 4 psi,
- 8 except boiler three-way and cooling tower bypass valves shall not have a pressure drop over 2 psi.
- 9 4. Two-way valves shall be 100% tight-closing. Three-way valves shall be 100% tight-closing in both
- 10 extreme positions.
- 11 5. Modulating two-way valves shall have equal percentage flow characteristics.
- 12 6. Modulating three-way valves shall have linear flow characteristics.
- 13 7. Piping geometry correction factors for C_v ratings shall be used and stated for ball valves or non-
- 14 characterized valves.
- 15 B. Two-position:
- 16 1. Ball 2" and under:
- 17 a. Design Pressure: 400 psi
- 18 Design Temperature: 212°F
- 19 Design Flow Differential Pressure Rating: 150 psi
- 20 b. Bronze or brass body, stainless steel stem, chrome plated brass or stainless steel full port
- 21 ball, PTFE or RTFE seats and seals, screwed ends (solder ends are acceptable only if rated
- 22 for soldering in line with 470°F melting point of 95-5 solder).
- 23 2. Ball 3" to 6":
- 24 a. Design Pressure: 200 psi
- 25 Design Temperature: 212°F
- 26 Design Flow Differential Pressure Rating: 35 psi
- 27 b. Cast iron body, stainless steel stem, stainless steel full port ball, PTFE or RTFE seats and
- 28 seals, flanged ends.
- 29 C. Modulating:
- 30 1. Ball 2" and under:
- 31 a. Design Pressure: 400 psi
- 32 Design Temperature: 212°F
- 33 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).
 - 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.

10 **2.20 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.

28 **2.21 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

- 1 adjustment, locking cover, 24 V control transformer (if not included with unit under
2 control), single or double pole as required.
- 3 2. Low Limit Switch:
- 4 a. Provide one foot of sensing element for each one square foot of coil area, maximum
5 element length 25 feet, of the vapor tension type, so that any point along the entire length
6 of measuring element is capable of triggering the switch.
- 7 b. Provide 3" minimum radius capillary support clips at each turn.
- 8 c. Furnish each thermostat with one single pole, single throw normally-opened switch and
9 one single pole, single throw normally-closed auxiliary switch.
- 10 d. Setpoint range shall be 15°F to 55°F with a permanent stop at 35°F.
- 11 e. Differential shall be fixed at approximately 5°F and supplied with manual reset.
- 12 B. Temperature Sensors:
- 13 1. Room Temperature Sensor:
- 14 a. Sensor Only: Honeywell TR23, Two-piece construction, ventilated plastic enclosure, off-
15 white color, thermistor sensing element or resistance temperature device (RTD), 45°F to
16 90°F operating range, ± 0.50°F accuracy, no setpoint adjustment or override button.
- 17 b. Sensor with Setpoint Adjustment: Honeywell TR 71, Two-piece construction, ventilated
18 plastic enclosure, off-white color, thermistor sensing element or resistance temperature
19 device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed single
20 setpoint adjustment (no numeric temperature scale – provide with a single
21 warmer/cooler or red/blue visual scale), no override button.
- 22 c. Sensor with Override: Honeywell TR 71, Two-piece construction, ventilated plastic
23 enclosure, off-white color, thermistor sensing element or resistance temperature device
24 (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, occupied/unoccupied override
25 button with LED, no setpoint adjustment.
- 26 d. Sensor with Setpoint Adjustment and Override: Honeywell TR 71, Two-piece construction,
27 ventilated plastic enclosure, off-white color, thermistor sensing element or resistance
28 temperature device (RTD), 45°F to 90°F operating range, ± 0.50°F accuracy, with exposed
29 single setpoint adjustment (no numeric temperature scale – provide with a
30 warmer/cooler or red/blue visual scale), occupied/unoccupied override button with LED.
- 31 2. Duct Temperature Sensor:
- 32 a. Thermistor or RTD type with 20K ohm rating. Pneumatic transmitters with transducers
33 are not acceptable.
- 34 3. Water Temperature Sensor:
- 35 a. Install in immersion wells. Separate thermometers as specified elsewhere, also of the
36 immersion well type, shall be installed within 2 feet of each temperature sensor.
- 37 4. In-slab Temperature Sensor
- 38 a. Slab sensor designed to measure temperature in concrete. Unit shall have high density
39 polyethylene sleeve for use in conduits. Unit shall be supplied with 20 feet of 2 conductor

- 1 cable. Operating range is -60°F to 140°F. Unit shall be 10K thermistor and be water
2 resistant.
- 3 b. Acceptable Manufacturer: Tekmar 072
- 4 C. Humidity Measuring Devices:
- 5 1. Humidity Sensors:
- 6 a. Humidity Sensors: Fully electronic with no moving parts or parts requiring periodic
7 service. Accuracy shall be \pm 2% of reading.
- 8 D. Pressure Measuring Devices
- 9 1. Differential Pressure Switches:
- 10 a. Standard Pressure Switches:
- 11 1) Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed
12 interior, designed to resist shock and vibration, and rated for 15 psig.
- 13 2) Accuracy shall be \pm 3% of full scale maximum throughout entire range at 70°F.
- 14 3) Provide mounting brackets, probes, and shutoff valves required for proper
15 installation.
- 16 4) The range and service shall be as required for application or as noted on the
17 drawings.
- 18 5) Provide two (2) photo-transistor-activated circuits and two (2) DPDT relays for
19 both high or low limit alarms or controls.
- 20 6) Provide latching relays that require manual reset once activated.
- 21 7) Acceptable Manufacturer: Dwyer Photohelic Series 3000.
- 22 b. High Pressure Switches (Manual Reset):
- 23 1) Differential pressure switch with single pole, double-throw snap switch and
24 enclosure.
- 25 2) Rated for pressure specified in sequence of control.
- 26 3) Electrical rating shall be 15 amps at 120-480 volts.
- 27 4) Setpoint adjustment shall be screw type located inside enclosure.
- 28 5) Provide optional manual reset for overpressure protection with all tubing,
29 brackets, and adapters.
- 30 6) Repeatability: \pm 3%.
- 31 2. Pressure Transmitters/Transducer:
- 32 a. Select device suitable for intended application; water or air, static or differential.
- 33 b. Select for appropriate range, including negative if applicable.

- 1 c. 100% solid state device, temperature compensated, suitable for pressures of 200% rated
2 range with averaging to stabilize output, accuracy of $\pm 1\%$ full scale, and a 4-20 mA output.
- 3 d. Provide a NEMA 4 enclosure unless panel mounted.
- 4 e. Air service shall have a minimum of three field selectable ranges.
- 5 f. When used for room pressure control, the transducer shall be bidirectional with a range
6 of ± 0.1 " W.C.
- 7 g. Provide pressure line outlet cover on both sides of the wall when used for room pressure
8 control.
- 9 h. Furnish with integral LED's to indicate Zero Pressure, Pressure In Range, and Pressure Out
10 Of Range as a diagnostic aid.
- 11 E. Flow Measuring Devices:
- 12 1. Flow Switches:
- 13 a. Suitable for the intended application (water or air system).
- 14 b. Vane Operated Flow Switch: Vane motion shall activate a single pole, double throw snap
15 switch.
- 16 2. Insertion Type Electromagnetic Flow Meter:
- 17 a. General:
- 18 1) Each flow meter shall be of the magnetic insertion type.
- 19 b. Service:
- 20 1) Heating Water: Rated for minimum of 240°F service.
- 21 c. Insertion Type Electromagnetic Flow Meter:
- 22 1) Each meter shall be rated for system pressure and shall have adequate
23 structural integrity for a flow rate equal to 150% of the scheduled maximum
24 initial or future flow rate, whichever is greater.
- 25 2) Each insertion type electromagnetic flow meter shall be complete with all
26 hardware necessary to enable insertion and removal of the meter without
27 system shutdown. The flow meter shall be hand insertable up to 400 PSI.
- 28 3) Construction:
- 29 a) Wetted Components: 316 stainless steel
30 b) Sensor Head: Polypropylene
31 c) Electronics enclosure shall be NEMA 4 and aluminum.
- 32 4) Each meter shall be wet calibrated against a primary volumetric standard that
33 is accurate to within 0.1% and traceable to NIST.

- 1 d. Output:
- 2 1) Output signals shall be completely isolated and shall consist of the following:
- 3 a) High resolution frequency output for use with peripheral devices such
- 4 as display module or BTU meter.
- 5 b) Analog output; 4-20mA, 0-10V, or 0-5V jumper selectable.
- 6 c) Scalable dry contact output for totalization.
- 7 2) The output shall be connected with display unit.
- 8 3) The meter shall include 25 feet of cable to connect with a remotely mounted
- 9 display unit.
- 10 4) Unless indicated otherwise, the initial span adjustment of each transmitter shall
- 11 be 0-120% of the scheduled maximum flow rate.
- 12 e. Accuracy:
- 13 1) The accuracy of each meter/transmitter assembly shall be $\pm 1.0\%$ of flow rate
- 14 reading over a range of 3-15 feet/second fluid velocity, with a repeatability of
- 15 0.1%. Accuracy at 1 foot/second shall be $\pm 2.0\%$.
- 16 f. Display Unit:
- 17 1) Pair with Display Unit described below.
- 18 g. BTU Meter:
- 19 1) Pair with BTU Meter described below.
- 20 h. Calibration:
- 21 1) Each meter shall be calibrated on a NIST traceable flow stand at 1, 8, and 15
- 22 FPS. Provide written documentation of calibration.
- 23 i. Installation Hardware
- 24 1) The flow meter shall be supplied with standard installation hardware, which
- 25 shall include, but not be limited to, full port bronze ball valve, brass close nipple
- 26 and weld-on carbon steel branch outlet.
- 27 j. Warranty:
- 28 1) Provide performance warranty of at least two years from the date of installation
- 29 and startup. Warranty shall cover parts and labor for repair or replacement of
- 30 the meter assembly. Performance during the warranty period shall satisfy the
- 31 above-stated requirements for accuracy and repeatability.
- 32 k. Approved Manufacturers:
- 33 1) ABB, Onicon, Magmeter.

- 1 3. Display Unit:
- 2 a. General:
- 3 1) The display shall compatible with virtually any flow meter.
- 4 2) The display module shall provide a local indication of liquid flow rate and net
5 totalized flow, along with associated engineering units (e.g., GPM/second and
6 gallons).
- 7 3) House in a steel wall-mounted enclosure with a built-in user interface/display.
- 8 4) Display unit shall accept 4-20 mA pulse or contact closure flow signals. It shall
9 also function as a network interface for two (2) additional analog rate inputs
10 and one (1) additional totalizing pulse input.
- 11 5) It shall support BACnet communication protocols.
- 12 6) The display shall have two-line alphanumeric LCD displays of flow rate and flow
13 total.
- 14 7) The display shall have non-volatile EEPROM memory that retains all program
15 parameters and totalized values in the event of power loss.
- 16 8) Electrical Power Supply: 24VAC. 60Hz, 500mA max.
- 17 b. Approved Manufacturers:
- 18 1) Onicon, Yokogawa.
- 19 4. Airflow Measuring Stations:
- 20 a. In accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, any
21 AFMS used to measure outside air CFM shall have an accuracy of $\pm 15\%$ of the design
22 minimum outdoor air flow rate (or better). The AFMS accuracy shall also comply with
23 requirements outlined in the following paragraphs of this specification.
- 24 b. Duct Mounted Airflow Measuring Stations (AFMS) - Thermal Dispersion
- 25 1) Provide airflow/temperature measurement devices where indicated on the
26 plans.
- 27 2) Each AFMS shall consist of one or more sensor probes and a single, remotely
28 mounted, microprocessor-based transmitter capable of independently
29 processing up to 16 independently wired sensor assemblies.
- 30 a) Each sensor assembly shall contain two individually wired,
31 hermetically sealed bead-in-glass thermistors.
- 32 b) Thermistors shall be mounted in the sensor assembly using a marine-
33 grade, waterproof epoxy. Thermistor leads shall be protected and not
34 exposed to the environment.
- 35 c) Devices using chip-in-glass or diode-case chip thermistors are not
36 acceptable.
- 37 d) Devices using less than two thermistors in each sensor assembly are
38 not acceptable.

- 1 e) Devices using platinum wire RTDs are not acceptable.
- 2 f) Devices having electronic circuitry mounted in or at the sensor probe
3 are not acceptable.
- 4 g) Pitot tubes and arrays are not acceptable.
- 5 h) Vortex shedding devices are not acceptable.
- 6 3) All Sensor Probes
- 7 a) Each sensor assembly shall independently determine the velocity and
8 temperature at its measurement point.
- 9 b) Each sensor assembly shall be calibrated at a minimum of 16 airflow
10 rates and 3 temperatures to standards that are traceable to the
11 National Institute of Standards and Technology (NIST).
- 12 c) Airflow measuring station assembly accuracy shall be +/-2% of
13 Reading over the entire operating airflow range. Temperature
14 accuracy shall be +/-0.15° F between -20° F and 160° F.
- 15 d) The operating humidity range for each sensor probe shall be 0-99%
16 RH (non-condensing).
- 17 e) Each sensor probe shall have an integral, UL listed, plenum rated
18 cable and terminal plug for connection to the remotely mounted
19 transmitter. A single manufacturer shall provide both the
20 airflow/temperature measuring probe(s) and transmitter for each
21 measurement location.
- 22 f) The number of probes shall be as recommended by the manufacturer
23 to achieve the specified accuracy.
- 24 4) Duct and Plenum Probes
- 25 a) Probes shall be constructed of extruded, gold anodized, 6063
26 aluminum tube. All wires within the aluminum tube shall be Kynar
27 coated.
- 28 b) Probe assembly mounting brackets shall be constructed of 304
29 stainless steel.
- 30 c) The operating airflow range shall be 0 to 5,000 FPM unless otherwise
31 indicated on the plans.
- 32 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

- 1 6) Transmitters
- 2 a) The transmitter shall have an integral 16 character alphanumeric LCD
3 display capable of simultaneously displaying individual airflow and
4 temperature.
- 5 b) The transmitter shall be capable of field configuration and diagnostics
6 using an on-board interface and LCD display.
- 7 c) The operating temperature range for the transmitter shall be -20° F
8 to 120° F.
- 9 d) The transmitter shall be capable of communicating with other devices
10 using one of the following interface options:
- 11 (1) Linear analog output signals for airflow and temperature:
12 Field selectable, fuse protected and isolated, 0-10VDC/4-
13 20mA (4-wire)
- 14 (2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP,
15 Modbus-RTU or Johnson Controls N2-Bus. BACnet devices
16 shall provide analog variables for airflow and temperature
17 containing individual sensor airflow rate and temperature
18 data.
- 19 (3) 10 Base-T Ethernet: Field selectable BACnet Ethernet,
20 BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link
21 libraries and VBA functions to interface Ethernet devices to
22 Microsoft Excel for remote monitoring of airflow and
23 temperature using a Windows 2000 or Windows XP based
24 PC.
- 25 (4) LonWorks Free Topology
- 26 c. Fan Inlet Airflow Measuring Stations - Differential Pressure:
- 27 1) Fan Inlet Measuring Station Pressure Sensors, Transmitters and Transducers:
- 28 a) Select for appropriate pressure range, fan type, inlet velocity, and
29 airflow volume.
- 30 b) Transmitter features and minimum performance requirements shall
31 be as follows:
- 32 (1) Combined Accuracy: ± 0.50%.
33 (2) Terminal Point Nonlinearity: ± 0.40%.
34 (3) Hysteresis: ± 0.02%.
35 (4) Non-repeatability: ± 0.05%.
36 (5) Compensation Range:
- 37 (a) Zero Shift: ±0.025% FS/°F.
38 (b) Span Shift: 0.025% FS/°F.
- 39 (6) Differential Overpressure: 5 psi proof and 25 psi burst
40 pressure.
41 (7) Output signal: 0 to 10 VDC.

- 1 c) Each transducer shall be provided with an integral manual zeroing
2 valve to allow for field calibration of the zero reference value without
3 the need for shutting the operating system down.
- 4 d) System airflow (measured in CFM) shall be continuously displayed on
5 an LCD display meter (0.5 inches high by 3.5 digits) located on the face
6 of the air volume/velocity transducer control enclosure.
- 7 d. Mounting of fan inlet static pressure sensing elements shall be in accordance with
8 manufacturer's published installation instructions to ensure accuracy of readings.
- 9 F. Current Measuring Devices:
- 10 1. Current Switches for Constant Speed Motors:
- 11 a. Digital device rated for amperage load of motor or device with split core design,
12 adjustable high and low trip points, 600 VAC rms isolation, induced power from the
13 monitored load, LED indicator lamps for output status and sensor power. The device shall
14 sense overloading, belt-loss, and power failure with a single signal.
- 15 2. Current Switches for Motors Controlled by VFD:
- 16 a. Digital device rated for amperage load of motor or device with split core design, factory
17 programmed to detect motor undercurrent conditions on variable or constant volume
18 loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms
19 isolation, induced power from the monitored load with NO output. The current sensor
20 shall store the motor current operating parameters in non-volatile memory and have a
21 pushbutton reset to clear the memory if the operating parameters change or the sensor
22 is moved to another load. The device shall sense overloading, belt-loss, and power failure
23 with a single signal. The sensor shall be mounted on the load side of variable frequency
24 drives.
- 25 G. Occupancy Sensors:
- 26 1. Ceiling mounted, passive infrared, 360° coverage pattern, zero crossing circuitry, adjustable
27 sensitivity and time delay (initial setting: Time delay - 5 minutes), integral isolated relay with
28 normally open and normally closed outputs, LED indicator, five-year warranty, UL listed. TCC shall
29 submit manufacturer supplied sensor layout drawing for shop drawing review. Provide full room
30 coverage as recommended by manufacturer.
- 31 H. Combination Carbon Monoxide/Nitrogen Dioxide Sensors:
- 32 1. Solid-state gas sensor/transmitter for each gas, NEMA 1 gasketed enclosure, normal operating
33 temperature 0-120°F, normal relative humidity operation 5-95%, ± 5% accuracy, and detection
34 range of 0-200 ppm. Unit shall be have a replaceable sensor element.
- 35 2. Provide separate 4-20 mA output from the sensor to the FMCS system for each gas.
- 36 3. Install with spacing per manufacturer and OSHA requirements.
- 37 4. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's
38 recommendations.
- 39 I. Carbon Dioxide Sensors:
- 40 1. Microprocessor based non-dispersive infrared sensor with range of 0 to 2,000 ppm CO2 with ± 100
41 ppm accuracy, maximum drift (compensated) of ± 5% full scale in five years, VOC software and
42 hardware sensing, duct mounting where applicable, 0-10V dc or 4-20 mA output directly

1 proportional to ppm, adjustable alarm limit, membrane filter, and terminal block. The diffusion gas
2 chamber in the sensor shall incorporate a reflective light pipe or wave guide surrounded by a gas
3 permeable membrane that prevents particulate contamination of the sensor. Unit shall have
4 selectable IAQ mode with output signal and sum of CO2 and VOC levels.

5 J. Miscellaneous Devices:

6 1. Control Relays:

7 a. Form "C" contacts rated for the application with "push-to-test" contact transfer feature
8 and an integral LED to indicate coil energization.

9 b. Mount all relays and power supplies in a NEMA 1 enclosure beside the FMCS panel or
10 controlled device and clearly label their functions.

11 2. Thermostat and Sensor Enclosures:

12 a. Clear plastic guard with lock. Wire guard with tamperproof screws. Setpoint shall be
13 adjustable with cover in place. Fasten to wall separately from thermostat. Provide guards
14 in all corridors, gymnasiums, locker rooms, toilet rooms, assembly halls and as noted on
15 the drawings.

16 3. Twist Timers:

17 a. Wall-mounted heavy duty, with rotary dial and face graduated in minutes or hours as
18 noted. Unit shall fit behind standard "decorator" wall plate. Color of timer and face plate
19 shall match remainder of project. Verify with Electrical Contractor. Provide wall plate
20 and engraved plastic label indicating service.

21 b. Switch shall be rated for 20 amps at 125 volts (10 amps at 277 volts) and fit standard 2-
22 1/2" deep electrical box.

23 c. Provide time cycle noted on the drawings or in the specifications; up to 12 hours.

24 d. Acceptable Manufacturers: Paragon SWD Series, Tork A500 Series, Intermatic FD Series,
25 or Marktime Series 93.

26 **2.22 CONDUIT**

27 A. Conduit and Fittings: Refer to Electrical Section 26 05 33 for materials and sizing.

28 **2.23 WIRE AND CABLE**

29 A. Wire and Cable Materials: Refer to Electrical Section 26 05 13 for wire and cable materials.

30 **PART 3 - EXECUTION**

31 **3.1 GENERAL INSTALLATION**

32 A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing
33 conditions.

34 B. Install system and materials in accordance with manufacturer's instructions.

35 C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to
36 meet the intent of the project documents shall be furnished and installed without additional cost.

- 1 D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and
2 repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit
3 adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.
- 4 E. Any room sensors or thermostats mounted on an exterior wall or column shall be mounted on a thermally
5 insulated sub-base. Sub-base to provide a minimum of one half inch of insulation. Seal the conduit into
6 backbox and any other opening that will affect the measurement.
- 7 F. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other
8 exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be
9 consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed 48". In
10 accordance with the requirements of LEED EQc1: Outdoor Air Delivery Monitoring, install all wall-mounted
11 CO2 sensors between 3 feet and 6 feet above the floor.
- 12 G. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other
13 controls.
- 14 H. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron
15 supports. One cabinet may accommodate more than one system in same equipment room.
- 16 I. After completion of installation, test and adjust control equipment.
- 17 J. Check calibration of instruments. Recalibrate or replace.
- 18 K. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this
19 section.
- 20 L. All controls associated with the proper operation of air handling units, pumps, or other mechanical equipment
21 served by emergency power shall be connected to the emergency power system. Control components shall
22 not be powered from the life safety branch of the emergency power system. Coordinate emergency power
23 source connections with the Architect/Engineer.
- 24 M. All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power
25 supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not
26 shown on the electrical drawings, are the responsibility of the TCC.
- 27 N. Labels For Control Devices:
- 28 1. Provide labels indicating service of all control devices in panels and other locations.
- 29 2. Labels may be made with permanent marking pen in the control panels if clearly legible.
- 30 3. Use engraved labels for items outside panel such as outside air thermostats.
- 31 4. Labels are not required for room thermostats, damper actuators and other items where their
32 function is obvious.
- 33 O. VFDs:
- 34 1. This project includes several variable frequency drives to control the flow of fans and/or pumps
35 based on a control variable.
- 36 2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.
- 37 3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A
38 separate relay must be used to indicate motor rotation in either hand or auto positions.

- 1 4. If a separate current transmitter or switch is indicated for status, install this device between the
2 VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the
3 VFD.
- 4 5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan
5 motor. Make connections such that fan will shut down whether in hand or auto position if the unit
6 has a bypass feature.
- 7 P. Airflow Stations:
- 8 1. The transmitter shall be installed at a location that is protected from weather, water, and vibration.
- 9 2. Mount transmitter where they can easily be read (36" to 66" above floor). Do not fasten
10 transmitters directly to ductwork or compromise duct insulation.
- 11 3. The manufacturer's authorized representative shall visit the project site during construction prior
12 to station installations to confirm all submitted sizes, mounting requirements and locations. Size
13 adjustments shall be made at no additional cost. The representative shall meet on site with the
14 TCC to support and train them on proper installation procedures and calibration.
- 15 4. Install labels at each sensor and transmitter identifying its service.
- 16 **3.2 GRAPHIC DISPLAY**
- 17 A. Create a customized graphic for each piece of equipment indicated on the itemized points list.
- 18 B. Components shall be arranged on graphic as installed in the field.
- 19 C. Include each graphic point listed in the itemized points list using real time data.
- 20 D. Provide a graphic representation of the following:
- 21 1. Where there are multiple buildings, color code the campus map by the systems serving that
22 building. The building graphic shall be linked to the graphic for that building's systems.
- 23 2. Where there are multiple floors, provide color codes/designations for the areas served by each AHU
24 and TAB by floor.
- 25 3. Where multiple AHUs serve one floor, color code the areas served by each AHU. The area shall be
26 linked to the graphic for that area's AHU.
- 27 4. Provide an overall floor plan of each floor of the building color coded by zone linked to the TAB for
28 that zone. The zone shall be linked to the graphic for that zone's TAB graphic.
- 29 5. Show the location of each thermostat on the floor plan.
- 30 6. Provide separate graphics showing the chilled and heating water system flow diagram. Show
31 temperatures and flows on the flow diagram. Each piece of equipment shown on the flow diagram
32 shall be linked to the graphic for that piece of equipment.
- 33 7. Provide a graphic showing the steam system flow diagram. Show pressures and flows on the flow
34 diagram. Each piece of equipment shown on the flow diagram shall be linked to the graphic for that
35 piece of equipment.
- 36 E. The FMCS shall include full graphic operator interface to display the following graphics as a minimum:
- 37 1. Home page to include a minimum of six critical points: Outside Air Temperature, Outside Air
38 Relative Humidity, Enthalpy, KWH, KW, etc.

- 1 2. Graphic floor plans accurately depicting rooms, walls, hallways, and showing accurate locations of
2 space sensors and major mechanical equipment.
- 3 3. Detailed graphics for each mechanical system including AHUs, ERUs, EFs, chillers, and boilers, as a
4 minimum.
- 5 4. Access corresponding system drawings, technical literature, and sequences of operations directly
6 from each system graphic.
- 7 F. The FMCS shall include individual graphical buttons to access the following data stored in PDF format:
- 8 1. Project control as-built documentation including all TCS drawings, diagrams and sequences of
9 operation.
- 10 2. TCS Bill of Material for each system, e.g. AHU, RTU, FCU, boiler, etc.
- 11 3. Technical literature specification data sheets for all components listed in the TCS Bill of Material.
- 12 **3.3 CONDUIT INSTALLATION**
- 13 A. Conduit Sizing and Installation: Refer to Electrical Section 26 05 33 for execution and installation.
- 14 1. Thermostats/temperature sensors shall be installed in junction boxes, flush with the wall, and shall
15 be coordinated for orientation with Architect/Engineer.
- 16 **3.4 WIRE AND CABLE INSTALLATION**
- 17 A. Wire and Cable Materials Installation: Refer to Electrical Section 26 05 13 for execution and installation.
- 18 B. Field Quality Control:
- 19 1. Inspect wire and cable for physical damage and proper connection.
- 20 2. Torque test conductor connections and terminations to manufacturer's recommended values.
- 21 3. Perform continuity test on all conductors.
- 22 4. Protection of cable from foreign materials:
- 23 a. It is the Contractor's responsibility to provide adequate physical protection to prevent
24 foreign material application or contact with any cable type. Foreign material is defined
25 as any material that would negatively impact the validity of the manufacturer's
26 performance warranty. This includes, but is not limited, to overspray of paint (accidental
27 or otherwise), drywall compound, or any other surface chemical, liquid or compound that
28 could come in contact with the cable, cable jacket or cable termination components.
- 29 b. Overspray of paint on any cable, cable jacket or cable termination component will not be
30 accepted. It shall be the Contractor's responsibility to replace any component containing
31 overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with
32 harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test
33 results of the cable containing overspray. Should the manufacturer and warrantor of the
34 structured cabling system desire to physically inspect the installed condition and certify
35 the validity of the structured cabling system (via a signed and dated statement by an
36 authorized representative of the structured cabling manufacturer), the Owner may, at
37 their sole discretion, agree to accept said warranty in lieu of having the affected cables
38 replaced. In the case of plenum cabling, in addition to the statement from the
39 manufacturer, the Contractor shall also present to the Owner a letter from the local
40 Authority Having Jurisdiction stating that they consider the plenum rating of the cable to
41 be intact and acceptable.

- 1 C. Installation Schedule:
- 2 1. Conduit terminations to all devices installed in applications with rotating equipment,
3 expansion/contraction or vibration shall be made with flexible metallic conduit, unless noted
4 otherwise. Final terminations to exterior devices installed in damp or wet locations shall be made
5 with liquidtight flexible metallic conduit. Terminations in hazardous areas, as defined in the
6 National Electrical Code, shall be connected using flexible conduit rated for the environment.

7 **3.5 FMCS INSTALLATION**

- 8 A. Coordinate voltage and ampacity of all contacts, relays, and terminal connections of equipment being
9 monitored or controlled. Voltage and ampacity shall be compatible with equipment voltage and be rated for
10 full ampacity of wiring or overcurrent protection of circuit controlled.
- 11 B. Naming Conventions: Coordinate all point naming conventions with Owner standards. In the absence of
12 Owner standards, naming conventions shall use equipment designations shown on plans.

13 **3.6 COMMISSIONING**

- 14 A. Refer to specification 07 91 00 for additional requirements.
- 15 B. Upon completion of the installation, this Contractor shall load all system software and start up the system.
16 This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required
17 operational checks to ensure that the system is functioning in full accordance with these specifications.
- 18 C. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat
19 tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the
20 input and output points of the FMCS system operation.
- 21 D. This Contractor shall prove that the controls network is functioning correctly and within acceptable
22 bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and
23 statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown
24 to have at least 25% spare capacity for future expansion.
- 25 E. Upon completion of the performance tests described above, repeat these tests, point by point, as described
26 in the validation log above in the presence of Owner's Representative, as required. Properly schedule these
27 tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to
28 prevent delay of occupancy permits or building occupancy.
- 29 F. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the
30 required testing to show performance compliance with the requirements of the Contract Documents to the
31 satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and
32 review of all corrected deficiencies.

33 **3.7 PREPARATION FOR BALANCING**

- 34 A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- 35 B. Check the calibration and setpoints of all controllers.
- 36 C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences
37 such as sunlight, drafts, or cold walls.
- 38 D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless
39 specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum cfm.
- 40 E. Verify the operation of all interlock systems.

1 **3.8 TEST AND BALANCE COORDINATION**

- 2 A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and
3 balance purposes.
- 4 B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of
5 these tools.
- 6 C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until
7 the first 20 terminal units are balanced.
- 8 D. The tools used during the test and balance process shall be returned at the completion of the testing and
9 balancing.

10 **3.9 DEMONSTRATION AND ACCEPTANCE**

- 11 A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation
12 of all controls and systems. Describe the normal operation of all equipment.

13 **3.10 TRAINING**

- 14 A. On-Site:
- 15 1. After completion of commissioning, the manufacturer shall provide 8 hours of training on
16 consecutive days for 4 Owner's representatives. The training course shall enable the Owner's
17 representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor
18 with experience in presenting the training material and the system programmer for this project
19 shall perform the training.

- 20 B. Day-to-Day Operations - Training Description:
- 21 1. Proficiently operate the system.
- 22 2. Understand control system architecture and configuration.
- 23 3. Understand FMCS systems components.
- 24 4. Understand system operation, including FMCS system control and optimizing routines (algorithms).
- 25 5. Operate the workstation and peripherals.
- 26 6. Log-on and off the system.
- 27 7. Access graphics, point reports, and logs.
- 28 8. Adjust and change system setpoints, time schedules, and holiday schedules.
- 29 9. Recognize malfunctions of the system by observation of the printed copy and graphic visual signals.
- 30 10. Understand system drawings and Operation and Maintenance manual.
- 31 11. Understand the job layout and location of control components.
- 32 12. Access data from FMCS controllers and ASCs.
- 33 13. Operate portable operator's terminals.

- 34 C. Advanced Operations - Training Description:
- 35 1. Make and change graphics on the workstation.
- 36 2. Create, delete, and modify alarms, including annunciation and routing of these.
- 37 3. Create, delete and modify point trend logs and graph or print these both on and ad-hoc basis and
38 at user-definable time intervals.
- 39 4. Create, delete, and modify reports.
- 40 5. Add, remove, and modify system's physical points.
- 41 6. Create, modify and delete programming.
- 42 7. Add panels when required.
- 43 8. Add operator interface stations.
- 44 9. Create, delete, and modify system displays, both graphic and others.
- 45 10. Perform FMCS system field checkout procedures.

- 1 11. Perform FMCS controller unit operation and maintenance procedures.
2 12. Perform workstation and peripheral operation and maintenance procedures.
3 13. Perform FMCS system diagnostic procedures.
4 14. Configure hardware including PC boards, switches, communication, and I/O points.
5 15. Maintain, calibrate, troubleshoot, diagnose, and repair hardware.
6 16. Adjust, calibrate, and replace system components.
- 7 D. System Management - Training Description:
- 8 1. Maintain software and prepare backups.
9 2. Interface with job-specific, third-party operator software.
10 3. Add new users and understand password security procedures.
- 11 E. Provide course outline and materials in accordance with the "SUBMITTALS" article in Part 1 of this section.
12 The instructor(s) shall provide one copy of training material per student.
- 13 **3.11 INSTALLATION OF SENSORS**
- 14 A. Install sensors in accordance with the manufacturer's recommendations.
15 B. Mount sensors rigidly and adequately for the environment within which the sensor operates.
16 C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall
17 framing.
18 D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from
19 other areas affecting sensor readings.
20 E. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight
21 downward incline away from the sensor making a serpentine pattern over the cross-sectional area with
22 elements spaced not over 12" apart and within 6" of the top and bottom of the area.
23 F. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature
24 sensors with heat-conducting fluid in thermal wells.
25 G. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated
26 location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by
27 Architect.
28 H. Install all wall-mounted CO2 sensors between 3 feet and 6 feet above the floor.
- 29 **3.12 INSTALLATION OF FLOW METERS**
- 30 A. Provide manufacturer's recommended lengths of straight piping upstream and downstream of the flow
31 meter. Up to 30 diameters upstream of the flow meter may be required depending on the piping
32 arrangement and flow meter type.
33 B. Maintain adequate pull/service space.
- 34 **END OF SECTION**

**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.

1.2 SUBMITTALS

- A. Submit shop drawings per Section 23 05 00. Include list that indicates use, operating range, total range and location for manufactured components.

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.

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.

1 B. Select scales to cover expected range of temperatures.

2 **2.4 TEST PLUGS**

3 A. Test Plug: 1/4" or 1/2" brass fitting and cap, with Nordel core for temperatures up to 275°F, for receiving
4 1/8" outside diameter pressure or temperature probe. Plugs shall be rated for zero leakage from vacuum to
5 500 psi.

6 B. Provide extended units for all plugs installed in insulated piping.

7 C. Test Kit: Carrying case, internally padded and fitted containing one 3-1/2" diameter pressure gauge with
8 0-100 psi range, one gauge adapter with 1/8" probes, two 1-1/2" dial thermometers with 0° to 220°F and
9 -25°F to 125°F ranges and 5" stems.

10 D. Acceptable Manufacturers: Sisco, Flow Design, or Peterson Equipment.

11 **2.5 STATIC AND DIFFERENTIAL AIRFLOW PRESSURE GAUGES**

12 A. Diaphragm-activated gauge with 4-3/4" dial, cast aluminum case, sealed interior, designed to resist shock
13 and vibration, and rated for 15 psig.

14 B. Accuracy shall be ± 3% of full scale maximum throughout entire range at 70°F.

15 C. Provide mounting brackets, probes, and shutoff valves required for proper installation.

16 D. The range and service shall be as required for application or as noted on the drawings.

17 E. Acceptable Manufacturers: Dwyer Magnehelic Series 2000, Marshalltown Instrument Series 85C.

18 **PART 3 - EXECUTION**

19 **3.1 INSTALLATION**

20 A. General Installation Requirements:

21 1. Install per manufacturer's instructions.

22 2. Coil and conceal excess capillary on remote element instruments.

23 3. Install gauges and thermometers in locations where they are easily read from normal operating
24 level.

25 4. Do not install instrumentation when areas are under construction, except for required rough-in,
26 taps, supports and test plugs.

27 B. Pressure Gauges:

28 1. Connect pressure gauges to suction and discharge side of all pumps.

29 2. Provide snubber for each pressure gauge.

30 3. Provide coil syphon for each pressure gauge connected to steam piping.

- 1 C. Thermometers:
- 2 1. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than
- 3 2-1/2" for installation of thermometer sockets.
- 4 2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor
- 5 sockets.
- 6 3. Locate duct thermometers minimum 10 feet downstream of mixing dampers, coils, or other
- 7 devices causing air turbulence.

8 **END OF SECTION**

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**SECTION 23 21 00
HYDRONIC PIPING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Geothermal 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 SUBMITTALS

- A. Submit product data under provisions of Section 23 05 00. Include data on pipe materials, fittings, valves, and accessories.

1.4 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.

1.5 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

GEOTHERMAL WATER EXTERIOR TO BUILDING

- A. Refer to 23 57 33 specification.

GEOTHERMAL WATER INTERIOR TO BUILDING

- B. Design Pressure: 125 psig.
Maximum Design Temperature: 225°F. (230°F for mechanical couplings)
- C. 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.

- 1 D. Piping - 2-1/2" and Over:
- 2 1. Pipe: Standard weight black steel, beveled ends, ASTM A53, Type E or S, Grade B.
- 3 2. Joints: Butt-welded or flanged.
- 4 3. Fittings: Standard weight wrought steel, butt-welding type, ASTM A234, ASME B16.9.
- 5 4. Flanges: Class 150 forged steel, welding neck or slip-on, ASTM A181 or A105, Class 60, ASME B16.5
6 up to 24" and B16.47 above 24". ASME B16.1 for flanges mating with flat face equipment flanges.
- 7 E. Shutoff Valves:
- 8 1. Ball Valves:
- 9 a. BA-1: 2" and under, 150 psi saturated steam, 600 psi WOG, full port, screwed or solder
10 ends (acceptable only if rated for soldering in line with 470°F melting point of lead-free
11 solder), bronze body of a copper alloy containing less than 15% zinc, stainless steel ball
12 and stem, Teflon seats and seals. Milwaukee #BA-400
- 13 NOTES:
- 14 1) Provide extended shaft with operating handle of non-thermal conductive
15 material and protective sleeve that allows operation of valve, adjustment of the
16 packing, and adjustment of the memory stop without breaking the vapor seal
17 or disturbing the insulation for all valves in insulated piping.
- 18 b. BA-1A: 2-1/2" and over: 150 psi saturated steam, 275 psi WOG ANSI Class, 150 psi
19 standard port, ductile iron body, FPA fused stainless steel ball and trim, Teflon seats and
20 seals. American Valve 4000D
- 21 NOTES:
- 22 1) Provide extended shaft for all valves in insulated piping.
- 23 F. Throttling Valves:
- 24 1. Globe Valves:
- 25 a. GL-1: 2" and under, 125 psi saturated steam, 300 psi WOG, screwed, bronze. Crane #7TF,
26 Stockham #B22T, Walworth #95, Milwaukee #590, Hammond #IB413T, Watts #B-4010-T,
27 NIBCO #T-235.
- 28 b. GL-2: 2-1/2" thru 10", 125 psi S @ 353°F, 200 psi WOG @ 150°F, flanged, iron body,
29 bronze mounted. Crane #351, Hammond #IR116, Stockham #G-512, Walworth #906F,
30 Milwaukee #F2981, Watts #F-501, NIBCO #F-718-B.
- 31 c. GL-5: 2" and under, 300 psi WOG, solder, bronze. Hammond #IB423, Stockham #B24T,
32 Milwaukee #1590, Watts #B-4011-T, NIBCO #S-235.
- 33 G. Check Valves:
- 34 1. CK-1: 2" and under, 125 psi S @ 353°F, 200 psi WOG @ 150°F, screwed, bronze, horizontal swing.
35 Crane #37, Hammond #IB904, Stockham #B319, Walworth #406, Milwaukee #509, Watts #B-5000,
36 or NIBCO #T-413.
- 37 2. CK-4: 2" and under, 200 psi WOG @ 150°F, solder, bronze, horizontal swing. Crane #1342,
38 Hammond #IB912, Stockham #B309, Walworth #406SJ, Milwaukee #1509, Watts #B-5001, or NIBCO
39 #S-413.

- 1 3. CK-13: 2-1/2" thru 12", 200# WOG, double disc wafer type, iron body, bronze or aluminum-bronze
2 discs, 316SS shaft and spring, Viton, EPDM or BUNA-N, Cv of at least 700 in 6" size. Mueller Steam
3 Specialty Co. #71-AHB-6-H, Stockham #WG-961, NIBCO W-920-W, Crane, Victaulic #716/716H.
- 4 H. Strainers:
- 5 1. ST-1: Bronze body, screwed ends, screwed cover, 150 psi S @ 350°F, 200 psi WOG @ 150°F.
6 Armstrong #F4SC, Metraflex #TS, Mueller Steam Specialty Co. #351, Sarco #BT, Watts #777, NIBCO
7 T-122.
- 8 2. ST-2: Cast iron body, 125 lb. flanged ends, bolted cover, 125 psi S @ 350°F, 175 psi WOG @ 150°F.
9 Armstrong #A1FL, Metraflex #TF, Mueller Steam Specialty Co.#758, Sarco #CI-125, Watts #77F-D,
10 Victaulic #732 or #W732, NIBCO F-721-A.
- 11 **2.2 EQUIPMENT DRAINS AND OVERFLOWS**
- 12 A. Copper Tubing: DWV drawn temper seamless copper drainage tube, ASTM B306.
- 13 1. Fittings: ASME B16.23 cast brass, or ASME B16.29 solder wrought copper.
- 14 2. Joints: Solder with Type 95-5 solder. 50-50 solder is not acceptable.
- 15 B. Piping Under 1-1/4" Size:
- 16 1. In sizes where drainage type fittings are not available, tees with threaded caps to permit rodding
17 are acceptable.
- 18 **2.3 AIR VENTS**
- 19 A. At end of main and other points where large volume of air may be trapped - Use 1/4" globe valve, angle type,
20 125 psi, Crane #89, attached to coupling in top of main, 1/4" discharge pipe turned down with cap.
- 21 B. On branch lines and small heating units - Use coin-operated air vent equal to B&G #4V, attached to 1/8"
22 coupling in top of pipe. Install air vents on all coils and terminal heating units.
- 23 **2.4 AUTOMATIC AIR VENTS**
- 24 A. Low capacity automatic air vent (for bladder tank anti-thermosyphon loops). Maximum operating pressure
25 and temperature of at least 240°F and 125 psi, 1/2" or 3/4" inlet. B&G #87, Armstrong, Spirotherm, or Watts.
- 26 B. High/low capacity automatic air vent (for air separator connection). Maximum operating pressure and
27 temperature of at least 240°F and 125 psi, 3/4" inlet, 3/8" minimum outlet. B&G #107, Armstrong,
28 Spirotherm, Taco, or Watts.
- 29 **2.5 STRAINERS**
- 30 A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as
31 follows:
- | Pipe Size | |
|------------------------|----------|
| Water and Glycol/Water | 20# mesh |
- 32 B. Furnish pipe nipple with ball valve, threaded hose connection, and cap to blow down all strainer screens.
- 33 C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

- 1 **2.6 SUCTION DIFFUSER**
- 2 A. Furnish and install on base mounted pumps with inlet size same as pipe size shown on the drawing.
- 3 B. In no case shall pressure drop exceed 3.0 psi.
- 4 C. Suction diffuser shall consist of angle body with inlet vanes and combination diffuser-strainer-orifice cylinder
5 with 3/16" diameter openings for pump protection, gauge tappings, and blowdown connection. Orifice
6 cylinder, with bronze or stainless steel strainer with free area at least 5 times cross section area of pump
7 suction opening. Furnish adjustable foot to support weight of suction piping. Connect drain valve to
8 blowdown connection. Provide 16 mesh bronze startup strainer. The startup strainer shall be removed after
9 the system has been started, cleaned, and is operating under normal conditions, but before the system is
10 turned over to the Owner. Hang the startup strainer on the piping near the pump after it is removed.
- 11 D. Acceptable Manufacturers: Amtrol, Armstrong, Bell & Gossett, Patterson, Taco, Wheatley, Victaulic.
- 12 **2.7 BALANCING VALVE**
- 13 A. Rated for 125 psi working pressure and 250°F operating temperature, taps for determining flow with a
14 portable meter, positive shutoff valves for each meter connection, memory feature, tight shutoff, and a
15 permanent pressure drop between 1' and 2' water column at full flow with valve 100% open. Furnish with
16 molded, removable insulation covers.
- 17 B. Provide a nomograph to determine flow from meter reading (and valve position on units which sense pressure
18 across a valve). Graph shall extend below the specified minimum flow.
- 19 C. Furnish one meter kit equivalent to Bell & Gossett Model RO-5 meeting the following requirements:
- 20 1. Carrying case with handle.
- 21 2. Pressure gauge with 0-25 feet of head scale with 3.0% full scale accuracy.
- 22 3. High and low side hoses with 5 feet length and 250 psig pressure rating, equipped with shutoff
23 valves, vent valves, and probes for insertion into pressure and temperature plugs.
- 24 D. Valves in copper piping shall be brass or bronze. Acceptable Manufacturers: Flow Design "Accusetter", Presso
25 "B+", Armstrong "CVB", Bell & Gossett "Circuit Setter Plus", Griswold "Quickset", Gerand "BALVALVE Venturi",
26 HCl "Terminator B", NIBCO 1710 (S1710L), Tour&Anderson (STAD), Nexus Valve "UltraXB Orturi",
27 Victaulic 785.
- 28 E. Valves in ferrous piping 2" or smaller shall have threaded ends and steel, brass or bronze construction.
29 Acceptable Manufacturers: Flow Design "Accusetter", Presso "B+", TA Hydronics "786-789", Armstrong
30 "CVB", Bell & Gossett "Circuit Setter Plus", Autoflow "AB", Gerand "BALVALVE Venturi", HCl "Terminator B",
31 NIBCO 1710 (T1710L), Nexus Valve "UltraXB Orturi", Victaulic 787, or flow sensors specified in Section
32 23 09 00 with a specified throttling valve.
- 33 F. Balancing valves in ferrous piping over 2" size shall consist of flow sensors as specified in Section 23 09 00
34 combined with specified throttling valves.
- 35 G. Manufacturer shall size balancing valves for the scheduled flow rate. Flow rate shall be measurable on
36 manufacturer's standard meters.
- 37 **2.8 EXPANSION TANK**
- 38 A. Bladder Type:
- 39 1. Tank shall be welded steel, ASME construction and stamped.

- 1 2. Tank shall be complete with heavy-duty replaceable butyl bladder, site glass, charging valve, lifting
2 ring, drain tapping, and system connection.
- 3 3. 125 psig working pressure and 240°F maximum operating temperature.
- 4 4. Acceptable Manufacturers: Bell & Gossett , Thrush, Taco, Armstrong, Watts, Wessels, Wheatley,
5 Amtrol, Patterson, John Wood.

6 **2.9 COALESCING TYPE COMBINATION AIR ELIMINATOR AND DIRT SEPARATOR**

- 7 A. Coalescing type air eliminator and dirt separator shall be fabricated from steel and ASME constructed and
8 certified for 125 psi working pressure and 270°F operating temperature. Units 2-1/2 inches and smaller shall
9 have threaded connections. Units 3 inches and larger shall have flanged connections.
- 10 B. Air elimination and dirt separation shall be by coalescing action by either:
- 11 1. Stainless steel PALL rings.
- 12 2. Copper tubes with continuous wound, permanently attached copper wire and followed by a
13 separate continuous wound permanently affixed copper wire.
- 14 C. Provide unit with factory mounted air vent at the top of the air elimination chamber.
- 15 D. Provide brass flushing cock on the separator side to facilitate system fast-fill and to blow down impurities
16 from the water surface within the separator.
- 17 E. Provide factory mounted blow-down valve on the unit bottom to allow for draining and cleaning.
- 18 F. Coalescing separators shall be as sized on the construction drawings, but in no case shall it have less than line
19 size connections nor shall pressure drop exceed 1 psi at design flow. Include on submittal the pressure drop
20 of each unit at its design flow rate.
- 21 G. Coalescing separators shall be equipped with removable cover to allow for removal, inspection and cleaning
22 of the internal coalescing media.
- 23 H. Acceptable Manufacturers: Spirotherm VDN Series, Wessels WVA, Taco.

24 **2.10 DRAIN VALVES AND BLOWDOWN VALVES**

- 25 A. Drain valve and blowdown valve shall mean a shutoff valve as specified for the intended service with added
26 3/4" male hose thread outlet, cap, and retaining chain.

27 **2.11 PROPYLENE GLYCOL - FOOD GRADE**

- 28 A. Fill systems with a 25% solution by weight of water and industrially inhibited propylene glycol low
29 temperature industrial heat transfer fluid with an expected life of at least 12 years in normal use. Water shall
30 meet the glycol manufacturer's recommendations (generally < 25ppm chloride, sulfite, and hardness).
31 Distilled, deionized, or reverse osmosis water is acceptable, as are pre-diluted solutions from the
32 manufacturer.
- 33 B. Glycol shall be approved by Wisconsin DNR for geothermal applications.
- 34 C. All ingredients shall be FDA recognized as safe food additives. Fluid suitable for use from -28°F to 250°F.
- 35 D. Glycol shall pass ASTM D1384 (less than 0.5 mils annual penetration of all system metals). Glycol supplier
36 shall provide a certificate of assurance.

1 E. For performance purposes a 50% solution by weight shall depress the freezing point to at least -34°F. At 40°F
2 the solution shall have viscosity of not over 14 centipoises, thermal conductivity of at least 0.199 Btu/hr*ft*°F,
3 specific heat of at least 0.839 Btu/lbm*°F, and specific gravity of at least 1.06. However, as described above
4 the project requires a 25% solution by weight of propylene glycol.

5 F. Manufacturer shall offer a testing service to determine if inhibitor addition is needed.

6 G. Acceptable Manufacturer: Dow Chemical "Dowfrost", Interstate Chemical "P-323", Houghton Chemical "Safe-
7 T-Therm

8 **2.12 GLYCOL FEED SYSTEM**

9 A. Package system complete with storage tank, pump(s) and controls with audio and visual alarm, designed to
10 add glycol solution to a closed loop water system. System shall automatically maintain pressure in the piping
11 system.

12 B. Provide cut-off and alarm to stop pump in case of low level or high pressure. Provide dry contact for alarm
13 point to the DDC.

14 C. Complete with polyethylene storage tank and lid. Mount on floor above pumping assembly in a steel frame
15 with legs. Lid shall be removable for filling and provide means for system relief valve outlet to be piped back
16 to tank without removal of piping from relief valve or automatic air vent

17 D. Pumping system shall consist of a pump, starter, pressure tank with pressure control, pressure reducing valve,
18 shutoff valve and pressure gauge. Refer to schedule for pump requirements.

19 E. Acceptable Manufacturer: Wessels GMP, Advantage Controls AGF, B&G GMU, Taco. Patterson, John Wood.

20 **2.13 LOCK OUT TRIM**

21 A. Provide lock out trim for all quarter turn valves opening to atmosphere installed in heating water piping over
22 120°F and as indicated on the drawings.

23 **PART 3 - EXECUTION**

24 **3.1 PREPARATION**

25 A. Ream pipe and tube ends, remove burrs, bevel plain end ferrous pipe.

26 B. Remove scale and dirt on inside and outside before assembly.

27 C. Connect to all equipment with flanges or unions.

28 D. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for treatment.

29 **3.2 TESTING PIPING**

30 A. Geothermal Water (inside building):

31 1. Test pipes underground or in chases and walls before piping is concealed.

32 2. Complete testing before insulation is applied. If insulation is applied before pipe is tested and a leak
33 ruins the insulation, replace all damaged insulation.

34 3. Test the pipe with 100 psig water pressure. Hold pressure for at least two hours.

- 1 4. Test to be witnessed by the Architect/Engineer or their representative, if requested by the
2 Architect/Engineer.
- 3 **3.3 CLEANING PIPING**
- 4 A. Assembly:
- 5 1. Prior to assembly of pipe and piping components, remove all loose dirt, scale, oil and other foreign
6 matter on internal or external surfaces by means consistent with good piping practice subject to
7 approval of the Architect/Engineer. Blow chips and burrs out of pipe before assembly. Wipe cutting
8 oil from internal and external surfaces.
- 9 2. During fabrication and assembly, remove slag and weld spatter from both internal and external
10 joints by peening, chipping and wire brushing to the degree consistent with good piping practices.
- 11 3. Notify the Architect/Engineer prior to starting any post erection cleaning operation in time to allow
12 witnessing the operation. Properly dispose of cleaning and flushing fluids.
- 13 4. Prior to blowing or flushing erected piping systems, disconnect all instrumentation and equipment,
14 open wide all valves, control valves, and balance valves, and verify all strainer screens are in place.
- 15 B. Chemical Cleaning:
- 16 1. Flush pipe and components with clean water until all discharge from system is clean. Maintain
17 minimum velocities at all points of 5 feet/second for 30 minutes. Flow shall be in same direction as
18 when system is in normal operation. Discharge shall be from low points of pipes, ends of headers
19 and as otherwise needed to flush entire system. After flushing, all residual water shall be drained
20 and/or blown out.
- 21 2. Add 2 pounds of trisodium phosphate per 100 gallons of system capacity. Use an alternate chemical
22 if discharge of trisodium phosphate is not permitted. Maintain 150°F in the system if possible. If
23 heat is not available, use 3 pounds per 100 gallons.
- 24 3. Drain the system after circulating the chemical cleaner for six hours at 150°F, or 12 hours at a lower
25 temperature. Refill. Test a water sample. Drain and fill again if excessive cleaning chemicals remain
26 and until water appears clear.
- 27 4. After circulating the chemical cleaner for six hours at 150°F, or 12 hours at less than 90°F, connect
28 fresh water to the system and discharge to a drain. Run circulating pumps and flush until discharge
29 is clear water.
- 30 5. When system water is clear, remove, clean and replace all strainers.
- 31 6. Add chemical treatment as specified in Section 23 25 00.
- 32 7. Water samples may be taken by the Architect/Engineer to verify a clean system. If system is not
33 clean, the entire process, including chemical treatment specified in Section 23 25 00, shall be
34 repeated at the Contractor's expense.
- 35 8. Chemical cleaning applies to the following systems:
- 36 a. Heating Water
37 b. Geothermal Water

1 **3.4 INSTALLATION**

2 A. General Installation Requirements:

- 3 1. Route piping in orderly manner, straight, plumb, with consistent pitch, parallel to building structure,
4 with minimum use of offsets and couplings. Provide only offsets required for needed headroom or
5 clearance and needed flexibility in pipe system.
- 6 2. Install piping to conserve building space, and not interfere with other work.
- 7 3. Group piping whenever practical at common elevations.
- 8 4. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected
9 equipment.
- 10 5. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the
11 largest pipe shown connecting to it. Where pipe sizes are not shown, the larger size in either
12 direction shall continue through the fitting nearest to the indication of a smaller pipe size.
- 13 6. Install bell and spigot pipe with bells upstream.
- 14 7. Seal pipes passing through exterior walls with a wall seal per Section 23 05 29. Provide Schedule 40
15 galvanized sleeve at least 2 pipe sizes larger than the pipe.
- 16 8. Branch takeoffs shall be from the top side (if branch is two sizes smaller than main), or any angle
17 from the horizontal plane to the top of piping.

18 B. Installation Requirements in Electrical Rooms:

- 19 1. Do not install piping or other equipment above electrical switchboards or panelboards. This
20 includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and
21 depth equal to the equipment plus its required clearance space.

22 C. Buried Piping:

- 23 1. Install thrust blocking and restraints on all buried piping at elbows and other changes in pipe
24 direction.

25 D. Valves/Fittings and Accessories:

- 26 1. Provide chain operators for all valves over 2" size that are over 10'-0" above finished floor. Extend
27 to 7'-0" above finished floor.
- 28 2. Provide valve position indicator on all valves 10'-0" or greater above finish floor and not located
29 above ceiling.
- 30 3. Provide clearance for installation of insulation, and access to valves and fittings.
- 31 4. Provide access doors where valves are not exposed.
- 32 5. Where a manual balance valve is shown to be installed in series with a service (isolation) valve,
33 separate balance and service (isolation) valves shall be installed.
- 34 6. Install balancing valves with the manufacturers recommended straight upstream and downstream
35 diameters of pipe.
- 36 7. Prepare pipe, fittings, supports, and accessories for finish painting.

- 1 8. Install valves with stems upright or horizontal, not inverted, except install manual quarter turn
2 valves in radiation cabinets and all butterfly valves with stems horizontal.
- 3 9. Provide shutoff valves and flanges or unions at all connections to equipment, traps, and items that
4 require servicing.
- 5 10. Provide flanges or unions at all final connections to equipment, traps and valves.
- 6 11. Arrange piping and piping connections so equipment may be serviced or totally removed without
7 disturbing piping beyond final connections and associated shutoff valves.

8 **3.5 PIPE ERECTION AND LAYING**

- 9 A. Carefully inspect all pipe, fittings, valves, equipment and accessories prior to installation. Immediately reject
10 and remove from the job any items which are unsuitable, cracked or otherwise defective.
- 11 B. All pipe, fittings, valves, equipment and accessories shall have factory-applied markings, stampings, or
12 nameplates sufficient to determine their conformance with specified requirements.
- 13 C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into
14 piping, fittings, valves, equipment and accessories. Do not erect or install any unclean item.
- 15 D. During construction, until system is fully operational, keep all openings in piping and equipment closed at all
16 times except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges
17 or other items designed for this purpose.
- 18 E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings. Do not use miter
19 fittings, face or flush bushings, or street elbows. **2-1/2" and larger fittings shall be long radius type**, unless
20 otherwise shown on the drawings or specified. Construct welded elbows of angles not available as standard
21 fittings by cutting and welding standard elbows to form smooth, long radius fittings.
- 22 F. Use full and double lengths of pipe wherever possible.
- 23 G. Unless otherwise indicated, install all inlet and outlet piping, including shutoff valves and strainers, to coils,
24 pumps and other equipment at line size with reduction in size being made only at control valve or pump.
- 25 H. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion
26 loops where cold springing is indicated on the drawings.
- 27 I. Do not create, even temporarily, undue loads, forces or strains on valves, equipment or building elements.

28 **3.6 DRAINING AND VENTING**

- 29 A. Unless otherwise indicated on the drawings, all horizontal pipes, including branches, shall pitch 1" in 40 feet
30 to low points for complete drainage, removal of condensate, and venting.
- 31 B. Provide drain valves at all low points of water piping systems or where indicated on drawings for complete or
32 sectionalized draining. Drain valves are defined above.
- 33 C. Use eccentric reducing fittings on horizontal runs when changing size for proper drainage and venting. Install
34 all liquid lines with top of pipe and eccentric reducers in a continuous line.
- 35 D. Provide air vents at all high points and wherever else required for elimination of air in all water piping systems.
36 Do not use automatic air vents in glycol systems unless they are piped to the fill tank.
- 37 E. Air vents shall be in accessible locations. If needed to trap and vent air in a remote location, a 1/8" pipe shall
38 connect the tapping location to a venting device in an accessible location.

1 F. All vent and drain piping shall be of same materials and construction as the service involved.

2 **3.7 BRANCH CONNECTIONS**

3 A. Make branch connections with standard tee or cross fittings of the type required for the service unless
4 otherwise specified herein or detailed on the drawings.

5 B. At the option of the Contractor, branch connections from headers and mains may be cut into black steel pipe
6 using forged weld-on fittings.

7 C. Use of forged weld-on fittings is also limited as follows:

- 8 1. Must have at least same pressure rating as the main.
- 9 2. Header or main must be 2-1/2" or over.
- 10 3. Branch line is at least two pipe sizes under header or main size.

11 **3.8 JOINING OF PIPE**

12 A. Threaded Joints:

- 13 1. Ream pipe ends and remove all burrs and chips.
- 14 2. Protect plated pipe and valve bodies from wrench marks when making up joints.
- 15 3. Apply Teflon tape to male threads.

16 B. Flanged Joints:

17 1. Bronze flanges shall conform to B16.24 and ductile iron flanges to B16.42. Steel flanges shall be
18 raised face except when bolted to flat face cast iron flange.

19 2. Bolting shall be ASTM A307 Grade B with bolts and heavy hexagonal nuts conforming to ASME
20 B18.2.1 and B18.2.2.

21 3. Torque bolts in at least three passes, tightening to 1/3, 2/3, and final torque in a cross pattern with
22 an indicating torque wrench for equal tension in all bolts.

23 4. Gaskets for flat face flanges shall be full-face type. Gaskets for raised faced flanges shall conform
24 to requirements for "Group I gaskets" in ASME B16.5. All gaskets shall conform to ASME B16.21.
25 Unless otherwise specified, gaskets shall meet the following requirements:

26 a. Gasket material and thickness approved by manufacturer for intended service, chemical
27 compatibility, pipe system test pressure, and operating temperature range.

28 b. Maximum pressure rating of at least 250 psig.

29 c. Minimum temperature rating: -10°F.

30 d. Maximum temperature rating of at least 170°F for water and glycol solution systems
31 operating 140°F and less.

32 e. Maximum temperature rating of at least 250°F for water and glycol solution systems
33 operating above 140°F and up to 180°F.

34 C. Solder Joints:

- 35 1. Make up joints with 95% tin and 5% antimony (95-5) solder conforming to ASTM B32 Grade 95TA.
36 Cut copper tubing ends perfectly square and remove all burrs inside and outside. Thoroughly clean
37 sockets of fittings and ends of tubing to remove all oxide, dirt and grease just prior to soldering.
38 Apply flux evenly, but sparingly, to all surfaces to be joined. Heat joints uniformly to proper
39 soldering temperature so solder flows to all mated surfaces. Wipe excess solder, leaving a uniform
40 fillet around cup of fitting.

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 BASE MOUNTED END SUCTION PUMPS

- A. Type: Centrifugal, single stage.
- B. Casing: Cast iron, single suction, rated for greater of 150 psior 1.25 times actual working discharge pressure, flanged suction and discharge with gauge ports.
- C. Impeller: Bronze, fully enclosed, keyed to shaft.
- D. Shaft: High grade alloy steel with copper, bronze or stainless steel shaft sleeves.
- E. Bearings: Grease lubricated roller or ball bearings with grease fittings. If pump will be insulated, grease fittings shall be extended 3" with rigid pipe to clear the insulation.
- F. Drive: Flexible coupling with OSHA approved guard.

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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;

1 maximum working pressure of 500 psi, and maximum temperature of 200°F. Sporlan, Henry Valve
2 Company, Alco Valve.

3 **2.3 VALVES**

4 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-
5 out proof, PTFE seals, brass ball with equalizing orifice, visible position indication, seal cap, extended copper
6 connections, replaceable stem seals, compatible with all CFC, HCFC, and HFC refrigerants. Henry Valve
7 Company, Superior Valve, Alco Valve.

8 **2.4 CHECK VALVES**

9 A. CK-10: 1/4" thru 3-5/8", 500 psi, globe or angle pattern, brazed, brass body, cleaned-dried-plugged and
10 tagged at factory for refrigerant service. Henry Valve Company, Mueller, Wolf-Linde.

11 **2.5 PRESSURE RELIEF VALVES**

12 A. RV-5: Straight Thru or Angle Type: Brass body and disc, Teflon seat, factory sealed and stamped with ASME
13 UV and National Board Certification NB; selected to ANSI/ASHRAE 15.

14 **2.6 FILTER-DRIERS**

15 A. Replaceable Cartridge Angle Type: ANSI/AHRI 710, UL listed, brass or epoxy-coated steel shell, molded
16 desiccant high-water capacity filter core(s); maximum working pressure of 500 psi; maximum temperature
17 of 275°F; maximum pressure drop of 3 psi with R410a or 1.5 psi with R134a at system flow rate.

18 B. Permanent Straight Thru Type: ANSI/AHRI 710, UL listed, steel shell with molded desiccant filter core,
19 maximum working pressure of 500 psi, maximum pressure drop of 3 psi with R410a or 1.5 psi with R134a at
20 system flow rate.

21 **2.7 SUCTION FILTERS**

22 A. Replaceable Cartridge Angle Type: UL listed for 500 psi up to 2-18" size, and 400 psi for larger sizes, steel
23 shell that passes 1000-hour salt spray test with copper fittings, replaceable pleated filter element(s);
24 maximum pressure drops of 3 psi with R410a or 2 psi with R134a at system flow rate, capable of accepting
25 molded desiccant core for cleanup after compressor burnout, access valve in the removable end plate.
26 Install with side refrigerant inlet.

27 **2.8 SOLENOID VALVES**

28 A. Valve: AHRI 760; pilot operated; copper or brass body and internal parts; synthetic seat; stainless steel stem
29 and plunger assembly; extended solder ends to permit installation without disassembly; maximum working
30 pressure of 500 psi; normally closed. Maximum pressure drop at system flow of 5 psi for R410a and 3 psi for
31 R134a.

32 B. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, surge
33 protector and color-coded lead wires, integral junction box, Class F temperature rated, ANSI/UL 429.

34 **2.9 EXPANSION VALVES**

35 A. Angle or Straight Thru Type: ANSI/AHRI 750; materials suitable for system refrigerant, external equalizer,
36 adjustable super heat setting, balanced port design, suitable for horizontal or vertical installation, with
37 replaceable capillary tube and remote sensing bulb.

38 B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across
39 valve. Select valve for maximum load at design operating pressure and minimum 10°F super heat. Select to
40 avoid being undersized at full load or excessively oversized at part load.

1 **2.10 RECEIVERS**

- 2 A. All receivers shall have capacity to hold the entire refrigerant charge when 90% full at 90°F per ASHRAE 15-
3 78.
- 4 B. 6" and Smaller Internal Diameter: ANSI/AHRI 495, UL listed, steel or copper, brazed; 450 psi working
5 pressure, with tappings for inlet, outlet, and relief valve or fusible plug.
- 6 C. Over 6" Internal Diameter: ANSI/AHRI 495, welded steel; ASME U or UM stamped for 400 psi, with tappings
7 for inlet, outlet and pressure relief valve.

8 **2.11 SUCTION ACCUMULATORS**

- 9 A. All accumulators shall have capacity to hold 50% of the refrigerant charge when 90% full at 90°F per
10 ASHRAE 15-78, pressure drop equivalent to under 0.5°F at peak capacity, a finish that survives a 500-hour
11 salt spray test, vertical design with dip tube and screened oil inlet orifice, and a hot gas boil-out coil to
12 evaporate liquid refrigerant.
- 13 B. 6" and Smaller Internal Diameter: ANSI/AHRI 495, UL listed, steel or copper, brazed; 400 psi pressure rating,
14 with tappings for inlet, outlet, and pressure relief valve or fusible plug.
- 15 C. Over 6" Internal Diameter: ANSI/AHRI 495, welded steel, ASME U or UM stamped for 450 psi, with tappings
16 for inlet, outlet and pressure relief valve.

17 **PART 3 - EXECUTION**

18 **3.1 PREPARATION**

- 19 A. Ream pipe and tube ends. Remove burrs.
- 20 B. Remove scale and dirt on inside and outside before assembly.

21 **3.2 INSTALLATION**

- 22 A. Install specialties in accordance with manufacturer's instructions.
- 23 B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest
24 pipe shown connecting to it.
- 25 C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- 26 D. Install piping to conserve building space and not interfere with use of space.
- 27 E. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a
28 dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the
29 equipment.
- 30 F. Group piping whenever practical at common elevations and locations. Slope piping 1% in direction of oil
31 return.
- 32 G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- 33 H. Provide clearance for installation of insulation and access to valves and fittings.
- 34 I. Provide access doors for concealed valves and specialties.

- 1 J. Where pipe support members are welded to structural building frame, brush clean, and apply zinc rich
2 primer to welding.
- 3 K. Insulate piping and equipment; per Section 23 07 19 and Section 23 07 16.
- 4 L. Provide external equalizer piping on expansion valves, and locate expansion valve sensing bulb immediately
5 downstream of evaporator on suction line. Connect distributor to expansion valve outlet.
- 6 M. Install flexible connectors parallel to the shafts of compressors.
- 7 N. Fully charge system with refrigerant after testing.

8 **3.3 PIPE ERECTION AND LAYING**

- 9 A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are
10 unsuitable, cracked or otherwise defective shall be rejected and removed from the job immediately.
- 11 B. All pipe, fittings, valves, equipment and accessories shall have factory applied identification sufficient to
12 determine their conformance with specified requirements.
- 13 C. Exercise care at all times to prevent entry of foreign matter into piping, fittings, valves, equipment and
14 accessories. Do not erect or install any item that is not clean.
- 15 D. During construction, until system is fully operational, keep all openings in piping and equipment closed
16 except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind
17 flanges or other items designed for this purpose.
- 18 E. Change direction of pipes only with fittings or pipe bends. Change size only with fittings.
- 19 F. Cut all pipe to exact measurement and install without springing or forcing.

20 **3.4 APPLICATION**

- 21 A. Provide solenoid valves in liquid lines of systems, in oil bleeder lines to stop flow of oil and refrigerant into
22 the suction line when system shuts down, and in hot gas bypass lines, as applicable.
- 23 B. Provide refrigerant charging valve connections.
- 24 C. Provide replaceable cartridge filter-driers, with three-valve bypass assembly and suction filters without
25 bypass assembly.

26 **3.5 FIELD QUALITY CONTROL**

- 27 A. Test piping system with nitrogen at 300 psig for at least 8 hours without loss of pressure.
- 28 B. During the 8-hour period under the test pressure, strike all soldered joints sharply with a rubber or rawhide
29 mallet to cause failure of all weak joints.
- 30 C. After pressure testing, evacuate all refrigerant piping to at least 28" of mercury for 24 hours without loss of
31 vacuum. Evacuate at an ambient temperature of 70°F or higher.

32 **END OF SECTION**

1
2
SECTION 23 25 00
CHEMICAL (WATER) TREATMENT

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Treatment for Closed Systems (Glycol).
6 B. Chemical Feed Equipment.

7 **1.2 SUBMITTALS**

- 8 A. Submit shop drawings under provisions of Section 23 05 00.
9 B. Include system schematics, equipment locations, and controls schematics.
10 C. Submit product data indicating chemicals and equipment.
11 D. Submit manufacturer's installation instructions.
12 E. Submit reports indicating start-up of treatment systems is completed and operating properly. Include reports
13 indicating analysis of system water after cleaning and after treatment.

14 **1.3 EXTRA STOCK**

- 15 A. Provide clean cartridges or bags in all bypass (pot) feeders with filters.
16 B. Provide two complete sets of replacement cartridges or filters for each bypass (pot) feeder with filters and
17 sidestream filter installed. Deliver to Owner at job site.

18 **1.4 OPERATION AND MAINTENANCE DATA**

- 19 A. Submit operation and maintenance data.
20 B. Include data on pumps and other equipment including spare parts lists, procedures, and treatment programs.
21 C. Include step-by-step instructions on test procedures including target concentrations and test frequencies.
22 D. Include list of treatment chemicals and the MSDS for all chemicals.

23 **1.5 QUALIFICATIONS**

- 24 A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum
25 five years documented experience. Company shall have local representatives with water analysis laboratories
26 and full time service personnel.

27 **1.6 REGULATORY REQUIREMENTS**

- 28 A. Conform to all applicable codes and regulations for addition of non-potable chemicals to building mechanical
29 systems, and for discharge to public sewage systems.
30 B. Provide only chemicals approved for use and disposal by local authorities. Contact the Architect/Engineer if
31 any specified chemicals are prohibited.

1 **1.7 MAINTENANCE SERVICE**

- 2 A. Provide the following services to assist the owner in setting up and maintaining chemical treatment systems
3 for one year from Date of Substantial Completion:
- 4 1. Provide technical service visits to perform field inspections and make water analysis on site. Visits
5 shall be twice annually for closed systems and monthly for steam and cooling tower systems. For
6 cooling tower systems, monthly testing shall have dipslide culture counts, and quarterly water
7 samples shall be sent to a CDC Elite lab for culturing to establish baseline total organism and
8 Legionella counts. Detail findings in writing on proper practices, chemical treating requirements,
9 and corrective actions needed. Submit copies of the field service report after each visit to the
10 Owner and to the Mechanical Contractor. Any problems related to the operation of the chemical
11 treatment program shall be reported to the Architect/Engineer.
- 12 2. Provide laboratory and technical assistance services for warranty period.
- 13 3. Include one (1) hour training course for operating personnel, instructing them on installation, care,
14 maintenance, testing, and operation of water treatment systems. Arrange course at start-up of
15 systems.
- 16 4. Provide on-site inspections of equipment during scheduled or emergency shutdown to properly
17 evaluate success of water treatment program, and make recommendations in writing based upon
18 these inspections.
- 19 5. Provide sufficient chemicals for treatment and testing during warranty period.
- 20 B. The Chemical Treatment Subcontractor shall be responsible for assisting the Mechanical Contractor by adding
21 the chemical solutions required for cleaning each piping system. During the remainder of the warranty
22 period, the Chemical Treatment Subcontractor will be responsible for adding chemicals and doing other work
23 related to the operation of system such as boiler blowdown. The Chemical Treatment Contractor shall make
24 periodic tests of the chemical treatment program as called for above and recommend changes to Owner
25 when needed.

26 **1.8 WATER ANALYSIS**

- 27 A. Sample feedwater to determine appropriate chemical treatment. Contact the Architect/Engineer if test
28 indicates treatment required is different than that specified.

29 **PART 2 - PRODUCTS**

30 **2.1 ACCEPTABLE MANUFACTURERS**

- 31 A. Nalco.
32 B. Betz.
33 C. America's Best Water Treaters.
34 D. H-O-H Chemicals, Inc.
35 E. Industrial Water Management.
36 F. Garratt-Callahan Company.
37 G. Lakeland Chemical Specialties, Inc.
38 H. Iowa Water Management Corp.
39 I. Butler Chemical Company.
40 J. Eldon Water.
41 K. ChemTreat.
42 L. Watertech of America
43 M. Earthwise Environmental, Inc.
44 N. Rhomar Water Management, Inc.

1 **2.2 MATERIALS**

2 A. Closed System Treatment (Glycol):

3 1. The specified glycols contain initial charge of corrosion inhibitors, however, the pH after installation
4 must be checked and adjusted to maintain between 8.0 and 10.0 using inhibitors recommended by
5 the manufacturer (normally dipotassium phosphate).

6 **PART 3 - EXECUTION**

7 **3.1 INSTALLATION**

8 A. Install in accordance with manufacturer's instructions.

9 B. Install bypass (pot) feeder with top approximately 36" above the floor.

10 C. Coordinate with Contractor to provide temporary metering capabilities during system fill to determine overall
11 system volume.

12 D. For systems containing glycol, carefully review the glycol manufacturer's water requirements and coordinate
13 to provide system cleaning, flushing, and initial fill with the proper quality of water conforming to the
14 manufacturer's and these specifications.

15 **3.2 CLOSED-LOOP HYDRONIC SYSTEM WATER QUALITY STANDARDS**

16 A. Review equipment manufacturer's water quality standard to ensure water quality is sufficient to meet their
17 warranty requirements as well as to ensure peak heat transfer efficiency. Contractor shall maintain hydronic
18 systems within the more stringent of either the equipment manufacturer's requirements or those listed
19 below:

Measured Value	Multi-Metal Systems with Aluminum	Multi-Metal Systems with Stainless Steel	Multi-Metal Systems with Copper
pH Range	6.5 – 8.5	6.5 – 8.5	9.0 – 10.0
Alkalinity as CaCO ₃	100 – 500 mg/l	100 – 500 mg/l	100 – 500 mg/l
Hardness as CaCO ₃ *	100 – 500 mg/l	100 – 500 mg/l	100 – 500 mg/l
Suspended Solids	< 10 mg/l	< 10 mg/l	< 10 mg/l
Dissolved Solids	< 1,000 mg/l	< 1,000 mg/l	< 1,000 mg/l
Chlorides	< 150 mg/l	< 150 mg/l	< 150 mg/l
Iron	< 5.0 mg/l	< 5.0 mg/l	< 5.0 mg/l
Manganese	< 0.4 mg/l	< 0.4 mg/l	< 0.4 mg/l
Nitrate	< 100 mg/l	< 100 mg/l	< 100 mg/l
Sulfate	< 200 mg/l	< 200 mg/l	< 200 mg/l
Ammonia	< 5.0 mg/l	< 5.0 mg/l	< 5.0 mg/l
Free Copper	< 0.10 mg/l	< 0.10 mg/l	< 0.10 mg/l
Free Aluminum	< 3.0 mg/l		

* Minimum hardness only applies to softened water. If water from rivers or lakes is below 100 mg/l, remineralizing is not required.

20 B. Submit an independent third-party test report for each chemically treated closed-loop system showing
21 compliance with all measured values shown in the above table as part of project closeout documentation.

22 **END OF SECTION**

1 **SECTION 23 31 00**
2 **DUCTWORK**

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Galvanized Ductwork
- 6 B. Ductwork Reinforcement
- 7 C. Ductwork Sealants
- 8 D. Rectangular Ductwork - Single Wall
- 9 E. Rectangular Ductwork - Double Wall
- 10 F. Round and Flat Oval Ductwork - Single Wall
- 11 G. Flexible Duct
- 12 H. Leakage Testing
- 13 I. Ductwork Penetrations

14 **1.2 DEFINITIONS**

- 15 A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- 16 B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the
17 larger size shall continue through the fitting.

18 **1.3 COORDINATION DRAWINGS**

- 19 A. Reference Coordination Drawings article in Section 23 05 00 for required duct systems electronic CAD
20 drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.
- 21 B. Duct drawings shall be at 1/4" minimum scale complete with the following information:
 - 22 1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and
23 wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
 - 24 2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and
25 acoustical lagging.
 - 26 3. Location and size of all duct access doors.
 - 27 4. Room names and numbers, ceiling types, and ceiling heights.
 - 28 5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each
29 member.
- 30 C. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and
31 returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions
32 of original file copies an acceptable alternative for coordination drawings. Architectural plans will need to be
33 obtained from the Architect.

34 **PART 2 - PRODUCTS**

35 **2.1 GALVANIZED DUCTWORK**

- 36 A. General Requirements:
 - 37 1. Duct and reinforcement materials shall conform to ASTM A653 and A924.

- 1 2. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc
2 coating for two sides per ASTM A90) unless noted otherwise.
- 3 3. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per
4 ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
- 5 4. Ductwork reinforcement shall be of galvanized steel.
- 6 5. Ductwork supports shall be of galvanized or painted steel. Slip cable hangers are acceptable.
7 Acceptable manufacturers are Gripple, Ductmate, Duro Dyne, or Architect/Engineer approved.
- 8 6. All fasteners shall be galvanized or cadmium plated.

9 **2.2 DUCTWORK REINFORCEMENT**

10 A. General Requirements:

- 11 1. All reinforcement shall be external to the duct except that tie rods may be used with the following
12 limitations.
- 13 a. Ducts must be over 18" wide.
- 14 b. Duct dimensions must be increased 2" in one dimension (h or w) for each row of tie rods
15 installed.
- 16 c. Tie rods must not exceed 1/2" diameter.
- 17 d. Manufacturer of tie rod system must certify pressure classifications of various
18 arrangements, and this must be in the shop drawings.

19 **2.3 DUCTWORK SEALANTS**

- 20 A. One part joint sealers shall be water-based mastic systems that meet the following requirements: maximum
21 48-hour cure time, service temperature of -20°F to +175°F, resistant to mold, mildew and water, flame spread
22 rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable
23 for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL
24 181B-M.
- 25 B. Two-part joint sealers shall consist of a minimum 3" wide mineral-gypsum compound impregnated fiber tape
26 and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time,
27 service temperature of 0°F to 200°F, resistant to mold, mildew, and water, flame spread rating below 25 and
28 smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal
29 classes and pressure classes.
- 30 C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-
31 P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20°F to +250°F.
- 32 D. Joint sealers shall meet the volatile organic compound (VOC) limits of U.S. Green Building Council LEED credit
33 EQ 4.1, Low-Emitting Materials - Adhesives & Sealants (follow the latest edition at the time of bidding or as
34 referenced in these specifications).
- 35 E. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape
36 shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel
37 adhesion to steel and service temperature range from -20°F to +250°F. Acceptable manufacturers include:
38 Venture Tape 1581A, Compac #340, Scotch Foil Tape 3326, Polyken 339.

- 1 **2.4 RECTANGULAR DUCT - SINGLE WALL**
- 2 A. General Requirements:
- 3 1. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards
4 Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space
5 consuming reinforcement.
- 6 2. Transitions shall not exceed the angles in Figure 4-7.
- 7 B. Exceptions and modifications to the 2005 HVAC Duct Construction Standards are:
- 8 1. All ducts shall be cross-broken or beaded.
- 9 2. Turning vanes shall be used in all 90° mitered elbows, unless clearly noted otherwise on the
10 drawings. Vanes shall be as follows:
- 11 a. Type 1:
- 12 1) **Description:** Single wall type with 22-gauge (0.029") or heavier vanes, 3-1/4"
13 blade spacing, and 4" to 4-1/2" radius. Vanes hemmed if recommended by
14 runner manufacturer. Runners shall have extra long locking tabs. C-value
15 independently tested at below 0.26. EZ Rail II by Sheet Metal Connectors or
16 equal.
- 17 2) **Usage:** Limited to 3,000 fpm and vane lengths 36" and under.
- 18 b. Type 2:
- 19 1) **Description:** Double wall type with 3-1/4" blade spacing, 4-1/2" radius, 24-
20 gauge minimum, and SMACNA Type 1 runners. C-value below 0.27.
- 21 2) **Usage:** No limits other than imposed by the manufacturer. Provide
22 intermediate support for vanes over 48" long.
- 23 c. Turning vanes shall operate quietly. Repair or replace vanes that rattle or flutter.
- 24 d. Runners must be installed at a 45° angle. Elbows with different size inlet and outlet must
25 be radius type.
- 26 e. Omitting every other vane is prohibited.
- 27 3. Where smooth radius rectangular elbows are shown, they shall be constructed per SMACNA Figure
28 4-2. Type RE1 shall be constructed with a centerline duct radius R/W of 1.0. Where shown on
29 drawings, Type RE3 elbows with 3 vanes shall be used with centerline duct radius R/W of 0.6
30 (SMACNA r/W=0.1). RE1 or RE3 elbows may be used where mitered elbows are shown if space
31 permits. **Mitered elbows (with or without turning vanes) may not be substituted for radius**
32 **elbows.** Do not make branch takeoffs within 4 duct diameters on the side of the duct downstream
33 from the inside radius of radius elbows.
- 34 4. Rectangular branch and tee connections in ducts over 1" pressure class shall be 45° entry type per
35 Figs. 4-5 and 4-6. Rectangular straight taps are not acceptable above 1" pressure class.
- 36 5. Bellmouth fittings shown on return duct inlets shall expand at a 60-degree total angle horizontally
37 and vertically (space permitting) and have length of at least 25% of the smallest duct dimension.

- 1 6. Round taps off rectangular unlined ducts shall be flanged conical or bellmouth type (equal to
2 Buckley Bellmouth or Sheet Metal Connectors E-Z Tap), or 45° rectangular with transition to round
3 (equal to Sheet Metal Connectors Inc. High Efficiency Takeoff). Straight taps are acceptable if
4 pressure class is 1" or less, round duct is 12" diameter or less, and the tap is not located between
5 fans and TAB devices.
- 6 7. Duct offsets shall be constructed as shown on drawings. Additional offsets required in the field
7 shall be formed of mitered elbows without turning vanes for offsets up to 30° maximum angle in
8 accordance with SMACNA offset Type 2. Offsets of greater than 30° angle shall be formed of radius
9 elbows with centerline radius R/W=1.0 or greater. SMACNA Type 1 offsets are not permitted.
- 10 8. All lined duct shall utilize dovetail joints where round or conical taps occur. The dovetail joints shall
11 extend past the liner before being folded over.
- 12 9. Cushion heads are acceptable only downstream of TAB devices in ducts up to ± 2" pressure class,
13 and must be less than 6" in length.
- 14 10. Slide-on flanged transverse joint systems are acceptable provided they are a manufactured product
15 that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction
16 Standards for sheet and joint deflection at the specified pressure class.
- 17 a. Apply sealant to all inside corners. Holes at corners are not acceptable.
- 18 b. Acceptable Manufacturers: Ductmate Industries - 25/35/45, Nexus, Mez, or WDCI. Other
19 manufacturers must submit test data and fabrication standards and receive
20 Architect/Engineer's approval before any fabrication begins.
- 21 11. Formed-on flanged transverse joint systems are acceptable provided they are a manufactured
22 product that has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct
23 Construction Standards for sheet and joint deflection at the specified pressure class.
- 24 a. Apply sealant to all inside corners. Holes at corners are not acceptable.
- 25 b. Flanges shall be 24-gauge minimum (not 26 gauge).
- 26 c. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal
27 Connectors. Other manufacturers must submit test data and fabrication standards and
28 receive Architect/Engineer's approval before any fabrication begins.

29 **2.5 ROUND AND FLAT OVAL DUCTWORK - SINGLE WALL**

- 30 A. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted
31 for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet
32 the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional
33 area and insulation requirements. The substitution shall be coordinated with all other trades prior to
34 installation.
- 35 B. Snap lock seams are not permitted.
- 36 C. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular
37 ducts of the same gauge with dimensions equal to the flat span of the oval duct.
- 38 D. 90° elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least
39 1.5.
- 40 E. Duct and fittings shall meet the required minimum gauges listed in chapter 3 of the SMACNA requirements
41 for the specified pressure class. Ribbed and lightweight duct are not permitted.

- 1 F. Ductwork shall be suitable for velocities up to 5,000 fpm.
- 2 G. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous
3 welds at intersection of fitting body and tap.
- 4 H. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with
5 corrosion resistant paint to match galvanized duct color.
- 6 I. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded
7 seam type. SMACNA seams RL-2 and RL-3 are not permitted.
- 8 J. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular
9 ductwork.
- 10 K. Transverse Joint Connections:
- 11 1. Crimped joints are not permitted.
- 12 2. Ducts and fittings 36" in diameter and smaller shall have slip joint connections. Size fitting ends to
13 slip inside mating duct sections with minimum 2-inch insertion length and a stop bead. Use inside
14 slip couplings for duct-to-duct joints, and outside slip couplings for fitting-to-fitting joints.
- 15 3. Ducts and fittings larger than 36" shall have flanged connections.
- 16 4. Secure all joints with at least 3 sheet metal screws before sealing.
- 17 5. Slide-on flanges as manufactured by Ductmate Industries, Accuflange, or Sheet Metal Connectors
18 are acceptable. Self-sealing duct systems are also acceptable (Lindab, Ward "Keating Coupling").
- 19 **2.6 RECTANGULAR DUCT – DOUBLE WALL**
- 20 A. All applicable portions of Rectangular Duct – Single Wall shall apply.
- 21 B. Furnish and install double-wall insulated airtight duct as shown on the drawings.
- 22 C. Duct Construction:
- 23 1. Galvanized steel exterior wall with perforated galvanized interior wall: Interior galvanized surfaces
24 shall have round perforations. Inner liner shall have a film between the insulation and the
25 perforated interior wall to prevent air contact with the insulation.
- 26 2. Rectangular double wall duct shall be suitable for pressures listed in the ductwork application
27 schedule.
- 28 3. All ductwork gauges and reinforcement shall be as listed in SMACNA Duct Construction Standards
29 Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space-
30 consuming reinforcement.
- 31 4. Ducts shall be 2" thick unless specified otherwise and completely metal enclosed with annular space
32 completely filled with 1-1/2# density glass fiber insulation. Insulation shall have flame
33 spread/smoke developed ratings of less than 25/50 per ASTM E84, NFPA 255, or UL 723. [SPECIFIER:
34 If IECC is the applicable energy code, R-5 insulation (1-1/2" fiberglass) is required for some
35 applications, including supply and return air ductwork in a ceiling plenum on the top floor of a fully
36 ducted system, supply and return air ductwork in shafts on exterior side of building envelope,
37 supply and return air ductwork in crawl spaces, and ductwork that is direct buried. R-8 insulation
38 (2" of fiberglass) is required when supply or return air ductwork is located on the exterior of the
39 building.]

- 1 5. Divided flow fittings may be separate fittings or factory installed taps with the following
2 construction requirements:
- 3 6. Airtight, continuous welds at intersection of fitting body and tap.
- 4 7. Tap liner spot welded to inner liner with weld spacing not over 3".
- 5 8. Insulation packed around the tap area for complete cavity filling.
- 6 9. Carefully fit branch connections to cut-out openings in inner liner without spaces for air erosion of
7 insulation or sharp projections for noise and airflow disturbance.
- 8 10. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding
9 with corrosion resistant paint to match galvanized duct color.
- 10 11. Support inner liner of ducts and fittings with metal spacers welded to maintain spacing and
11 concentricity.
- 12 12. Formed-on flanged transverse joint systems are acceptable if they are a manufactured product that
13 has been tested for conformance with Chapter 2 of the SMACNA HVAC Duct Construction Standards
14 for sheet and joint deflection at the specified pressure class.
- 15 13. Apply sealant to all inside corners. Holes at corners are not acceptable.
- 16 14. Flanges shall be 24-gauge minimum (not 26 gauge).
- 17 15. Acceptable Manufacturers: Lockformer TDC, TDF, United McGill, or Sheet Metal Connectors. Other
18 manufacturers must submit test data and fabrication standards and receive Architect/Engineer's
19 approval before any fabrication begins.

20 **2.7 FLEXIBLE DUCT**

- 21 A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A
22 and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC
23 Seal of Certification.
- 24 B. Flame Spread/Smoke Developed: Not over 25/50.
- 25 C. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from
26 contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket,
27 sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.
- 28 D. Inner liner shall be airtight and suitable for 6" WC static pressure through 10" diameter and shall be airtight
29 and suitable for 4" WC static pressure 12" through 16" diameter. Outer jacket shall act as a vapor barrier only
30 with permeance not over 0.1 perm per ASTM E96, Procedure A. "R" value shall not be less than 4.0
31 ft²*°F*hr/Btuh. Temperature range of at least 0-180°F. Maximum velocity of 4,000 fpm.
- 32 E. Usage:
 - 33 1. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.
 - 34 2. Connections to air inlets and outlets. Do not exceed 3'-0" in length.
- 35 F. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose
36 flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.
- 37 G. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure
38 sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Provide openings in ducts for thermometers and controllers.
- 4 B. Locate ducts with space around equipment for normal operation and maintenance.
- 5 C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a
6 dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the
7 electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in
8 electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms
- 9 D. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent
10 dust from entering ductwork. Supply ductwork shall be free of construction debris, and shall comply with
11 level "B" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- 12 E. Repair all duct insulation and liner tears.
- 13 F. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers
14 at air terminal device or in outlets, unless specifically shown.
- 15 G. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.
- 16 H. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.
- 17 I. Flexible duct shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions
18 where required, to include, but not limited to, all connections to air inlets, air outlets, and terminal air boxes.
- 19 J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork
20 seams and joints shall be sealed watertight and pitched to shed water.
- 21 K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and
22 Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable.
23 Refer to Section 23 05 50 for seismic requirements.
- 24 L. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts,
25 plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per
26 ASTM E84, NFPA 255, or UL 723.

27 **3.2 DUCTWORK APPLICATION SCHEDULE**

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS†	INSULATION (Refer to Section 23 07 13 for insulation types)
Supply Duct from DOAS to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Rectangular	+3"	A	1" thick Type A
Supply Duct from DOAS to Terminal Air Boxes – Single Wall	Galvanized Sheet Metal - Round	+3"	A	1" thick Type A
Supply Duct from DOAS to Terminal Air Boxes	Galvanized Sheet Metal w/Slide-On Flange System or Formed-on Flanges	+3"	A	1" thick Type A
Supply Ductwork within Mechanical Room	Galvanized Sheet Metal - Rectangular	+3"	A	1" thick Type B
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Rectangular	+2"	A	1" thick Type A.

USAGE	MATERIAL	PRESSURE CLASS	SEAL CLASS†	INSULATION (Refer to Section 23 07 13 for insulation types)
Supply Duct from Terminal Air Boxes to Outlets	Galvanized Sheet Metal - Round	+2"	A	1" thick Type A.
Supply Duct downstream of VRF Indoor Units	Galvanized Sheet Metal	+2"	A	2" thick Type A
Return Duct	Galvanized Sheet Metal	-2"	A	None
Exhaust Duct from DOAS 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 DOAS	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
† Seal Class is per SMACNA HVAC Air Duct Leakage Test Manual				

1 **3.3 DUCTWORK SEALING**

2 A. General Requirements:

- 3 1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
- 4 2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to
5 comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in
6 accordance with that certification.
- 7 3. All connections shall be sealed including, but not limited to, taps, other branch connections, access
8 doors, access panels, and duct connections to equipment. Sealing that would void product listings
9 is not required. Spiral lock seams need not be sealed.
- 10 4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil
11 thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies
12 other application methods or requirements.

13 B. For Seal Class A ducts, all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed.
14 Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-
15 ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and
16 jams, duct, plenum, and casing abutments to building structures.

17 **3.4 TESTING**

18 A. Duct - 2" WG or Less (positive or negative):

- 19 1. Systems shall not leak more than shown in Table 4-1 of SMACNA HVAC Air Duct Leakage Test
20 Manual for Seal Class A.

- 1 2. Leak testing of these systems is not normally required for interior ductwork. However, leak tests
2 will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All
3 exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
- 4 3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
- 5 4. Seal ducts to bring the air leakage into compliance.
- 6 5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for
7 testing.
- 8 B. Duct - 3" WG and Above (positive or negative):
- 9 1. Duct system shall be completely pressure tested. If duct has outside wrap, testing shall be done
10 before it is applied.
- 11 2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
- 12 3. Seal ducts to bring the air leakage into compliance.
- 13 4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for
14 testing.
- 15 C. Test procedure shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the
16 following additional requirements:
- 17 1. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and
18 converting the results mathematically is not acceptable. This is required to test the structural
19 integrity of the duct system.
- 20 2. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless
21 of whether that section of duct passed the leakage test.
- 22 3. All joints shall be felt by hand, and all discernible leaks shall be sealed.
- 23 4. Totaling leakage from several tested sections and comparing them to the allowable leakage for the
24 entire system is not acceptable. Each section must pass the test individually.
- 25 5. Contractor shall notify the Architect/Engineer/Owner five business days prior to pressurizing
26 ductwork for testing. Failure to notify the Architect/Engineer/Owner of pressure testing may
27 require the contractor to repeat the duct pressure test after proper notification.
- 28 6. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary
29 report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
- 30 7. All access doors, taps to terminal air boxes, and other accessories and penetrations must be
31 installed prior to testing. Including terminal air boxes in the test is not required.
- 32 8. The required leakage class for Seal Class A, both round and rectangular ducts, shall be 4.
- 33 9. Positive pressure leakage testing is acceptable for negative pressure ductwork.

34 **3.5 DUCTWORK PENETRATIONS**

- 35 A. All duct penetrations of firewalls shall have fire or fire/smoke dampers where required by code.
- 36 B. Dampers shall be compatible with fire rating of wall assembly. Verify actual rating of any wall being
37 penetrated with Architect/Engineer.

1 C. Seal all duct penetrations of walls that are not fire rated by caulking or packing with fiberglass. Install
2 galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of
3 all rectangular openings in finished rooms.

4 **END OF SECTION**

**SECTION 23 33 00
DUCTWORK ACCESSORIES**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual Volume Dampers.
- B. Fire Dampers.
- C. Fabric Connectors.
- D. Duct Access Doors.
- E. 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 CURTAIN 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 with heated airflow at 2,000 fpm and 4" WC, and have all blades stacked out of the airstream (Type B).
- C. 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.
- D. Dampers shall be installed in sleeves of sufficient thickness to comply with the UL555 Standard for Safety Fire Dampers listing of the damper. Where UL555 permits sleeve thickness to be the same as that of the duct gauge, such thickness shall not be less than that specified in NFPA 90A for breakaway style sleeves. If a breakaway style duct/sleeve connection is not used, 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

1 not extend more than 6" beyond the firewall or partition unless damper is equipped with a factory installed
2 access door. Sleeve may extend up to 16" beyond the firewall or partition on sides equipped with the factory
3 installed access door.

4 E. Locate access door in the ductwork for visual inspection and on the latch side to replace link easily. Each
5 access door shall have a label with letters at least 1/2" high, reading "FIRE DAMPER".

6 **2.3 FABRIC CONNECTORS**

7 A. Fabric connectors shall be installed between all fans or fan units and metal ducts or casings to prevent transfer
8 of fan or motor vibration.

9 B. The fabric connectors shall be completely flexible material which shall be in folds and not drawn tight.

10 C. Fabric connectors shall be of glass fabric double coated with neoprene, with UL approval. Weight = 30 oz. per
11 square yard minimum. Fabric shall not be affected by mildew and shall be absolutely waterproof, airtight and
12 resistant to acids, alkalis, grease and gasoline, and shall be noncombustible.

13 D. Fabric connections shall not exceed 6" in length on ductwork that has a positive pressure. On ductwork that
14 has a negative pressure, the length shall not exceed 2" in length.

15 E. All corners shall be folded, sealed with mastic and stapled on 1" centers.

16 F. Fabric connectors shall not be painted.

17 G. Unless otherwise shown on the drawings, the fabric connection at the inlet to centrifugal fans shall be at least
18 one duct diameter from the fan to prevent inlet turbulence.

19 H. Acceptable Materials: Durodyne MFN-4-100, Vent Fabrics, Inc. "Ventglas", or Proflex PFC3NGA.

20 I. Fabric connectors exposed to sunlight and weather shall be as described above, except the coating shall be
21 hypalon in lieu of neoprene.

22 J. Acceptable Materials: Durodyne "Duralon MFD-4-100", Vent Fabrics, Inc. "Ventlon", or Proflex PFC3HGA.

23 **2.4 DUCT ACCESS DOORS**

24 A. Fabricate per Fig. 7-2 and 7-3 of the SMACNA HVAC Duct Construction Standards and as indicated.

25 B. Review locations prior to fabrication. Install access doors at fire dampers, smoke dampers, motorized
26 dampers, fan bearings, filters, automatic controls, humidifiers, louvers, duct coils and other equipment
27 requiring service inside the duct.

28 C. Construction shall be suitable for the pressure class of the duct. Fabricate rigid, airtight, and close-fitting doors
29 of materials identical to adjacent ductwork with sealing gaskets butt or piano hinges, and quick fastening
30 locking devices. For insulated ductwork, install minimum one inch thick insulation with sheet metal cover.

31 D. Access doors with sheet metal screw fasteners are not acceptable.

32 E. Minimum size for access doors shall be 24" x16" or full duct size, whichever is less.

33 F. Provide quantity of access doors such that two hands can fit inside ductwork to manually reset fire dampers.
34 This will typically require one access door on the bottom and one access door on an accessible side of the
35 duct for sizes 12x12 and smaller.

1 **2.5 DUCT TEST HOLES**

2 A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs,
3 or threaded or twist-on metal caps.

4 **2.6 DUCTWORK ACCESSORY SEALANTS**

5 A. Ductwork accessory sealants and adhesives shall conform to Section 23 31 00.

6 B. Joint sealers, adhesives, and sealants shall meet the low emitting materials limits in LEED v4 (latest edition at
7 the time of bidding or as referenced in these specifications). This requires a product's VOC level be tested and
8 determined to comply with CDPH Standard Method V1.1-2010. All adhesives and sealants wet applied on site
9 must also meet the applicable chemical content requirements of SCAQMD Rule 1168.

10 **PART 3 - EXECUTION**

11 **3.1 INSTALLATION**

12 A. General Installation Requirements:

13 1. Install accessories in accordance with manufacturer's instructions.

14 2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors.
15 Coordinate location with the Architect/Engineer.

16 3. Coordinate and install access doors provided by others.

17 4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible
18 ceiling. Minimum size shall be 24" x 24".

19 5. Provide duct test holes where indicated and as required for testing and balancing purposes.

20 B. Manual Volume Damper:

21 1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems
22 where branches are taken from larger ducts where indicated on drawings and as required for air
23 balancing. Use splitter dampers only where indicated.

24 2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are
25 located above an inaccessible ceiling and an access door cannot be installed, provide a remote-
26 controlled volume control device for operation of the damper. Coordinate location with the
27 Architect/Engineer.

28 3. Grease duct volume dampers shall be continuously welded to duct and/or hoods so that system is
29 liquidtight.

30 C. Fire Damper, Fire Smoke Damper, Smoke Damper:

31 1. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations
32 indicated, where ducts and outlets pass through fire rated components, and where required by
33 authorities having jurisdiction. Install with required perimeter mounting angles, sleeves and duct
34 connections.

35 2. Provide ceiling access doors for smoke and/or fire dampers. Coordinate location with the
36 Architect/Engineer.

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Duct Variable Air Volume Terminal Box.

1.2 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.

1.3 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. Casing: Minimum 22 gauge galvanized steel. Fully lined with minimum 1", minimum 1-1/2 pound density fiberglass insulation. Insulation shall be UL listed and meet NFPA 90A requirements.
- B. All insulation in contact with the air stream shall be foil faced, UL listed and NFPA 90A approved.
- C. Damper Blade: Extruded aluminum or minimum 18 gauge galvanized steel. Nylon or bronze bushings on damper shafts. Dampers shall seal against gasketed stops. Leakage shall not exceed 4% of unit nominal cfm at 3.0 inches WG inlet static pressure.
- D. Damper Operators: Electronic, furnished and installed by TCC. Refer to Section 23 09 00 for additional information.
- E. DDC Volume Controller: Electronic, furnished and installed by TCC. Boxes to be pressure independent control to maintain constant air volume regardless of duct pressure changes up to 6 inches w.c. Provide velocity and

- 1 static sensor at inlet to box for use by unit controller. Boxes shall be set for maximum and minimum settings
2 shown on the drawings. Refer to Section 23 09 00 for additional information.
- 3 F. Boxes shall not exceed the static pressure drop and N.C. level scheduled on the drawings.
- 4 G. Refer to control diagrams and notes on control drawings for complete sequence of control.
- 5 H. Acceptable Manufacturers: Carrier, Titus, Trane, Krueger, Carnes, E.H. Price, Tuttle & Bailey, Nailor, Enviro-
6 Tec, Johnson Controls Inc., Metalaire.

7 **PART 3 - EXECUTION**

8 **3.1 INSTALLATION**

- 9 A. Install in accordance with manufacturer's instructions.
- 10 B. Maintain minimum working clear space for all electrical connections in accordance with NFPA 70, National
11 Electrical Code.
- 12 C. Provide ceiling access doors or locate units above easily removable ceiling components.
- 13 D. Support units individually from structure. Do not support from adjacent ductwork.
- 14 E. Where boxes are located adjacent to a wall or joist, the damper motors and control valves shall be located
15 on the side of the box away from the wall or joist to permit easy access.

16 **3.2 ADJUSTING**

- 17 A. All boxes shall be set to the cfm shown on the drawings. TCC shall be responsible to field recalibrate all boxes
18 that are not set correctly.

19 **END OF SECTION**

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**SECTION 23 37 00
AIR INLETS AND OUTLETS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grilles And Registers.
- B. Architectural Square Panel 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.

- 1 E. The capacity and size of the unit shall be as shown on the drawings.
- 2 F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25,
3 referenced to 10⁻¹² watts with a 10 dB room effect.
- 4 G. Refer to the drawings for construction material, color and finish, margin style, deflection, and sizes of grilles
5 and registers.
- 6 H. Provide with 3/4" blade spacing. Blades shall have steel friction pivots to allow for blade adjustment, plastic
7 pivots are not acceptable.
- 8 I. Corners of steel grilles and registers shall be welded and ground smooth before painting. Aluminum grilles
9 and registers shall have staked corners.
- 10 J. Where specified to serve registers, provide opposed blade volume dampers operable from the face of the
11 register.
- 12 K. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners
13 for installation in lay-in ceilings and as specified on the drawings.
- 14 L. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.
- 15 **2.2 ARCHITECTURAL SQUARE PANEL DIFFUSERS**
- 16 A. Reference to a diffuser means an air supply device, ceiling mounted, that shall diffuse air uniformly
17 throughout the conditioned space.
- 18 B. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule. Flat-oval inlets
19 are not acceptable for connection to flexible ducts.
- 20 C. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system).
21 Any discrepancies in contract documents should be brought to the attention of the Architect/Engineer, in
22 writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been
23 coordinated.
- 24 D. The capacity and size of the unit shall be as shown on the drawings.
- 25 E. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25,
26 referenced to 10⁻¹² watts with a 10 dB room effect.
- 27 F. Diffusers shall be architectural solid square panel and flush with ceiling.
- 28 G. The exposed surface shall be smooth, flat and free of visible fasteners. The face panel shall be 22 gauge
29 steel with a rolled edge or shall be 18 gauge with a smooth ground, uniform edge.
- 30 H. The back pan shall be one piece 22 gauge stamped and shall include an integral inlet. (Welded inlets and
31 corner joints are not acceptable).
- 32 I. Diffusers with a 24x24 back pan shall have a minimum 18x18 face panel size. Diffusers with a 12x12 back
33 pan shall have a minimum 9x9 face panel size.
- 34 J. The face panel shall be mechanically fastened to the back panel with steel components. (Plastic fasteners
35 are not acceptable.)
- 36 K. Acceptable Manufacturers: Tuttle & Bailey, Titus, Price, Nailor, Carnes, Metalaire, Krueger.

1 **2.3 LINEAR DIFFUSERS**

2 A. Plenum Slot Diffusers (Lay-In):

- 3 1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule.
4 Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-
5 round transition if required.
- 6 2. The capacity and size of the unit shall be as shown on the drawings.
- 7 3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level
8 of 25, referenced to 10⁻¹² watts with a 10 dB room effect.
- 9 4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for
10 sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types
11 specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings
12 prior to submitting shop drawings.
- 13 5. Linear diffusers and mounting frames shall be furnished as one piece up to 5' in length.
- 14 6. Diffusers shall be furnished with factory installed adjustable "ice tong" style pattern deflectors
15 capable of providing 180° pattern adjustment.
- 16 7. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to
17 each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless
18 otherwise indicated on the drawings.
- 19 8. Number and width of slots shall be as shown on the drawings.
- 20 9. Provide integral plenum for each linear diffuser. Refer to linear diffuser supply plenum
21 specification section for details.
- 22 10. Acceptable Manufacturers: Tuttle & Bailey ITPS, Carnes DA, Price TBD, Krueger PTBS, Nailor 5800,
23 Titus TBD, Metalaire.
- 24 11. Linear diffusers for fire-rated ceiling shall be UL labeled with a non-adjustable air pattern. Airflow
25 direction shall be as shown on the drawings.
- 26 12. Acceptable Manufacturers for fire-rated diffusers: Kees FRK-UL, Titus TBD-FR, Krueger PFTBS,
27 Price TBD2-FR.

28 B. Linear Slot Diffusers (Continuous):

- 29 1. The type of unit, margin size, material, finish, etc., shall be as shown on the Drawing Schedule.
30 Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide sheet metal oval-to-
31 round transition if required.
- 32 2. The capacity and size of the unit shall be as shown on the drawings.
- 33 3. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level
34 of 25, referenced to 10⁻¹² watts with a 10 dB room effect.
- 35 4. Install T-bars on both sides of diffusers for lay-in ceiling system, install manufacturer frame for
36 sheetrock or plaster ceiling system. Diffuser margins system shall be compatible with ceiling types
37 specified, color to match ceiling system. Contractor shall coordinate margin types with ceilings
38 prior to submitting shop drawings.
- 39 5. Provide with concealed fasteners for installation in the field.

- 1 6. Linear diffusers and mounting frames shall be furnished as one piece up to 6' in length. Provide
2 auxiliary support per manufacturer's recommendations for slot diffusers greater than 4' in length.
- 3 7. Diffusers shall be furnished with adjustable pattern deflectors capable of providing 180° pattern
4 adjustment.
- 5 8. A manual volume damper shall be furnished and installed by the Contractor in branch ductwork to
6 each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless
7 otherwise indicated on the drawings.
- 8 9. Number and width of slots shall be as shown on the drawings.
- 9 10. Provide plenum for each linear diffuser. Refer to linear diffuser supply plenum specification
10 section for details.
- 11 11. Acceptable Manufacturers: Tuttle & Bailey 6000/7000, Carnes CH, Price SDS, Krueger 1900, Nailor
12 5000, Titus ML.

13 **2.4 LINEAR DIFFUSER SUPPLY PLENUM**

- 14 A. Linear diffusers shall be provided with field fabricated or prefabricated supply plenums. Plenum shall be a
15 minimum of 2-1/2" wider than total slot width, minimum length of slot, and minimum height of 10".
16 Plenums with end fed duct connections shall not exceed 8' in length. The cross sectional area of the plenum
17 shall be designed for a maximum velocity of 500 fpm and the aspect ratio shall be limited to a width-to-
18 height ratio of less than 1.5. Plenums with side outlets shall be designed for a maximum velocity of 600 fpm
19 and inlet ducts to plenum shall be spaced 5' on center maximum. Inlet ducts to plenums shall have a
20 maximum velocity of 900 fpm. Flat-oval inlets are NOT acceptable for connection to flexible ducts. Provide
21 sheet metal oval-to-round transition if required.
- 22 B. Plenum shall be constructed with 24 gauge galvanized steel and shall have side inlets unless shown
23 otherwise on the drawings. Refer to Ductwork Application Schedule in Section 23 31 00 for insulation
24 requirements.
- 25 C. End caps and required accessories shall be integral with the plenum or furnished and installed by the
26 Mechanical Contractor.
- 27 D. A manual volume damper shall be furnished and installed by the Mechanical Contractor in branch ductwork
28 to each slot diffuser. Balancing dampers shall not be installed in supply plenum or at air outlet unless
29 otherwise indicated on the drawings
- 30 E. Prefabricated plenums shall be by the same manufacturer as the linear diffuser or Kees Inc.

31 **2.5 LOUVERS - FIXED - ALUMINUM**

- 32 A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness
33 shall be minimum 0.081" Blades shall be spaced at a maximum of 5.1" apart.
- 34 B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and
35 diverted to the jamb.
- 36 C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.
- 37 D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.
- 38 E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more
39 than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the
40 scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25
41 gal/min as described under the Water Penetration Test in AMCA 500-L-07.

- 1 F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required
2 in masonry walls.
- 3 G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and
4 wall.
- 5 H. Louvers shall be suitable for duct connection.
- 6 I. Acceptable Manufacturers: Air Flow - "EA-403", Arrow - "EA-415-D", American Warming & Ventilating - "LE-
7 21", Construction Specialties - "A4097", Dowco - "DBE-4", Louvers & Dampers, Inc. - "IL-23", Ruskin -
8 "ELF375DX", Vent Products - "2760", Greenheck - "ESD-403", Pottorff - "EFD".

9 **PART 3 - EXECUTION**

10 **3.1 INSTALLATION**

- 11 A. General Installation Requirements:
- 12 1. Install items in accordance with manufacturers' instructions.
- 13 2. Check location of inlets and outlets and make necessary adjustments in position to conform to
14 architectural features, symmetry, and lighting arrangement.
- 15 3. Install diffusers to ductwork with air tight connections.
- 16 4. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round
17 transitions where required.
- 18 B. Volume Damper:
- 19 1. Provide manual volume dampers on duct take-off to diffusers when there are multiple
20 connections to a common duct. Locate volume dampers as far as possible from the air inlet or
21 outlet.

22 **END OF SECTION**

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**SECTION 23 40 00
AIR CLEANING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Filters and Filter Media.
- B. 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 and as needed for the TAB Contractor to perform their work.
- 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.

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SECTION 23 57 33
GEOTHERMAL HEAT EXCHANGERS

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Vertical Bore Type Ground Loop Geothermal Heat Exchanger.

6 **1.2 QUALITY ASSURANCE**

- 7 A. The Contractor must have on this project a certified IGSHPA installer. The Contractor performing this work
8 must have a minimum of three years experience in performing underground closed circuit, earth coupled,
9 vertical heat exchanger, including systems of 100 tons or larger.

- 10 B. Geothermal Heat Exchanger Fabricators must be heat fusion certified by an authorized high density
11 polyethylene (HDPE) pipe manufacturer's representative of the brand of pipe used. Certification must
12 include successful completion of a written heat fusion exam, as well as demonstrating proper heat fusion
13 techniques under the direct supervision of the authorized HDPE pipe manufacturer's representative.

- 14 C. Certified technicians must attend a retraining school annually. A single failure of a fusion joint will void the
15 certification, and the technician must be retested to demonstrate satisfactory performance.

- 16 D. Local, State, and Federal laws and ordinances, as they pertain to buried pipe systems, shall be strictly
17 followed or a variance obtained. Installation shall follow the recommendations of the National Ground
18 Water Association.

- 19 E. Procure applicable permits and licenses. Refer to 00 31 46 for additional details and requirements.

- 20 F. Verify that survey benchmark and intended elevation of grade at well field prior to beginning work.

- 21 G. Grouting compound shall be certified and listed by NSF (National Sanitation Foundation International) to
22 ANSI/NSF Standard 60, "*Drinking Water Treatment Chemicals - Health Effects*".

- 23 H. Drilling contractor shall be a licensed water well driller in the State of Wisconsin.

24 **1.3 REFERENCES**

- 25 A. ASTM D2610 – Solid Wall HDPE Conduit Based On Controlled Outside Diameter.

- 26 B. ASTM D2683 – Socket Fusion Fittings.

- 27 C. ASTM D3261 – Butt/Saddle Fusion Fittings.

- 28 D. ASTM D3350-93 – Polyethylene Plastic Pipe and Fittings.

- 29 E. International Ground Source Heat Pump Association (IGSHPA).

30 **1.4 SHOP DRAWINGS**

- 31 A. Submit shop drawings per Section 23 05 00.

- 32 B. Before geothermal heat exchanger construction begins, the Contractor must submit shop drawings to the
33 Design Architect/Engineer. The shop drawings shall include all applicable manufacturer's material
34 specifications, warranties, installer qualifications, material safety data sheets for all materials used in the
35 geothermal installation, all polyethylene piping and fitting materials, U-bend assemblies, and testing and
36 flushing procedure.

- 1 C. Submit detailed 1"=20' scale CAD drawing showing bore field layout, including site utilities and obstructions.
2 Drawing shall include all horizontal pipe routing.
- 3 D. Submit all underground piping pressure test results.
- 4 **1.5 DESCRIPTION OF WORK**
- 5 A. This design has been prepared in accordance with the materials standards and accepted installation
6 practices of the International Ground Source Heat Pump Association (IGSHPA). The Geothermal Contractor
7 shall comply with these standards and practices along with all state and local regulations pertaining to the
8 installation.
- 9 B. The Geothermal Contractor is responsible for all aspects involved with the complete geothermal loop field
10 installation. All materials, drilling, excavation, hauling of backfill, pumping, soil compaction, utilities
11 (including but not limited to water, electricity and fuel), and labor required shall be included in the bid price.
- 12 C. The Geothermal Contractor shall verify exact locations of utilities in the loop field. Some areas may require
13 hand digging to locate utilities. The Geothermal Contractor must include in the bid price the repair of any
14 sewer, domestic water, electrical, communication or any service line that may be damaged during the
15 construction of this project. Any offsets required to route over or under existing lines shall also be included
16 in the bid price of the project.
- 17 D. Refer to drawings for description of test bore drilling log results.
- 18 **1.6 WARRANTY**
- 19 A. Provide five (5) year warranty covering the entire installation for materials and workmanship. Warranty
20 shall cover leaks and settlement due to improper backfilling or compaction.
- 21 **1.7 UNIT PRICE**
- 22 A. Contractor shall submit as part of his/her bid a unit price per well for additional wells (up to 10%)
23 authorized by the Owner.
- 24 B. Contractor's Base Bid shall be based on the number and depth of wells described on the drawings.
- 25 **1.8 DESIGN**
- 26 A. A test bore and thermal conductivity test was performed at this site in July 2017. Refer to details 2/M401
27 and 3/M401 for partial results of the test bore and thermal conductivity test. A full copy of the test report is
28 available by request from the Owner or A/E.
- 29 **1.9 PROTECTION**
- 30 A. Protect trees, shrubs, lawns, rock outcropping, and other features remaining as a portion of final
31 landscaping. Place excavated material from trench on hard surface area, heavy mil sheet plastic or sheet
32 vinyl to minimize damage to grassed areas.
- 33 B. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from equipment and vehicular
34 traffic.
- 35 C. Protect above and below grade utilities that are to remain.
- 36 D. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent
37 cave-in or loose soil from falling into excavation.
- 38 E. Notify Architect/Engineer of unexpected subsurface conditions.

- 1 F. Protect bottom of excavations and soil adjacent to and beneath foundations from freezing.
- 2 G. Refer to Section 23 05 00 for other requirements.

3 **PART 2 - PRODUCTS**

4 **2.1 PIPE**

- 5 A. The pipe shall be PE4710 HDPE with a minimum cell classification of 345464C per ASTM D3350-93 and a
6 DR11 (200 psig) rating. This pipe will carry a warranty of no less than 50 years. Submit written warranty on
7 piping.
- 8 B. Each pipe shall be durably marked with the manufacturer's name, nominal size, pressure rating, relevant
9 ASTM standards, cell classification number and date of manufacture.
- 10 C. All piping used for the U-bend heat exchanger (pipe located in borehole) will have factory hot-stamped
11 lengths impressed on the side of the piping indicating the length of the heat exchanger at that point. The
12 length stamp shall read zero on one end and the actual heat exchanger total length on the other end.
- 13 D. The vertical heat exchanger will have a factory fused one-piece U-bend with pipe lengths long enough to
14 reach grade from the bottom of the bore. U-bends fabricated from two elbows are not permitted.
- 15 E. Approved pipe manufacturers are Chevron Phillips Driscoplex 5300, Vanguard, Plexco, Centennial Plastics.

16 **2.2 FITTINGS**

- 17 A. Pipe fittings shall meet the requirements of ASTM D2683 (for socket fusion fittings) or ASTM D3261 (for
18 butt/saddle fusion fittings). Each fitting shall be identified with the manufacturer's name, nominal size,
19 pressure rating, relevant ASTM standards, and date of manufacturer.

20 **2.3 BENTONITE GROUT (THERMALLY ENHANCED)**

- 21 A. Material: Thermally enhanced bentonite grout shall be used to seal and backfill each vertical u-bend well
22 bore of the closed-loop ground heat exchanger to ensure proper thermal contact with the earth and to
23 ensure the environmental integrity of each vertical bore column. The grouting material shall remain in a
24 plastic state (moldable) throughout the life of the system and shall not generate heat during the hydration
25 process. No other backfill material shall be accepted.
- 26 B. Thermal Conductivity: The thermal conductivity of the grouting compound must be 1.0 Btu/hr-ft-°F or
27 greater.
- 28 C. Permeability: The grout mixture shall also have a maximum permeability rate of less than 6.9×10^{-8} cm/s as
29 determined by using the "Falling-Head Method" (defined in the United States Army Corp of Engineers' Civil
30 Engineering Manual No. EM 1110-2-1906, "*Laboratory Soils Testing*") as recommended by the U.S.
31 Environmental Protection Agency to ensure proper sealing. Permeability shall be verified by an
32 independent lab, with a copy of the report being supplied to the Architect/Engineer/Owner.
- 33 D. Packaging: Grouting materials shall be pre-manufactured and packaged prior to delivery to the site. If the
34 grouting material supplier does not supply sand additive, Contractor shall obtain pre-approval from the
35 Architect/Engineer prior to site use as a thermal enhancement additive.
- 36 E. Product: Grouting material shall be Black Hills Bentonite's Thermal Grout Select as supplied by GeoPro, Inc.,
37 Barotherm Gold by Baroid Industrial Drilling Products, or Cetco High TC Geothermal Grout.

38 **2.4 TRACER WIRE**

- 39 A. Refer to 23 05 53 for Tracer Wire Requirements.

1 **2.5 WARNING TAPE**

2 A. Provide warning tape above underground piping per the requirements of Section 23 05 53.

3 **2.6 LOCATING WIRE**

4 A. Provide locating wire around perimeter of borefield and supply and return piping to building. Termination
5 of locating wire should be on exterior of the building near where the piping enters the building. Refer to
6 sheet M001 for location. Refer to 23 05 53 for additional requirements.

7 **2.7 FIELD LOCATION**

8 A. Bore locations shall be confined to the area designated on the accompanying drawings. Bore locations to be
9 individually surveyed after drilling is complete, but before horizontal trenching is done.

10 B. Maker balls shall be provided at the four corners of the bore field. Refer to 23 05 53 for requirements.

11 C. Provide detailed GPS coordinates of each corner.

12 D. Final bore locations are to be surveyed and GPS located.

13 **2.8 PROPYLENE GLYCOL**

14 A. All products shall be compatible with the propylene glycol heat transfer fluid. Refer to section 23 21 00 for
15 propylene glycol requirements.

16 **PART 3 - EXECUTION**

17 **3.1 PREPARATION**

18 A. Identify required lines, levels, contours, and datum.

19 B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.

20 C. Notify the Owner and coordinate the removal and relocation of utilities. At the Owner's direction, the
21 Contractor shall notify utility company to remove and relocate utilities.

22 **3.2 DRILLING**

23 A. The vertical boreholes will be drilled to a depth allowing complete insertion of the vertical heat exchanger
24 to its specified depth. The maximum borehole diameter will be six inches. If a larger diameter is required,
25 prior approval must be granted by the Design Architect/Engineer.

26 B. Refer to drilling log or obtain subsurface conditions from another source.

27 **3.3 U-BEND HEAT EXCHANGER ASSEMBLY**

28 A. The U-bend heat exchanger pipe shall be air fill pressurized to 100 psig to check for leaks before insertion.
29 If necessary, an iron (sinker) bar can be attached at the base of each vertical heat exchanger u-bend to
30 overcome buoyancy. This iron bar will have all sharp edges adequately taped to avoid scarring and/or
31 cutting of the HDPE pipe. No driving rod that is pulled out after U-bend insertion will be allowed. The
32 entire assembly shall be inserted to the specified depth in the borehole.

1 **3.4 GROUTING PROCEDURES**

- 2 A. The U-bend heat exchanger shall be pressure grouted from the bottom up to the ground surface in a
3 continuous fashion using a one inch HDPE tremie pipe. The tremie pipe will be pulled out during the
4 grouting procedure, maintaining the pipe's end just below grout level within the borehole. All state
5 regulations will be met for borehole grouting of a vertical heat exchanger.
- 6 B. Slurry mixture and grouting process shall conform to "Grouting Procedures: As published by IGSHPA 1991."
- 7 C. All bore holes shall be grouted immediately after loop pipe installation. Bore hole grouting shall be
8 monitored, and all grout quantities consumed shall be documented. Drill cuttings/chips shall not be used as
9 grout or bore hole fill material. All voids, fractures, or highly permeable formations shall be noted on the
10 well log, along with means used to stop grout loss/subsidence.

11 **3.5 HEAT FUSION PIPE JOINING**

- 12 A. All underground pipe joining shall be heat fused by socket, butt, or saddle (sidewall) fusion in accordance to
13 ASTM D2610, ASTM D2683, and the manufacturer's heat fusion specifications. The operator shall be heat
14 fusion certified and experienced in executing quality fusion joints.

15 **3.6 EXCAVATION AND BACKFILLING FOR PIPING**

- 16 A. General Requirements:
- 17 1. The Contractor shall do all excavating, backfilling, shoring, bailing, and pumping for the installation
18 of their work and will perform necessary grading to prevent surface water from flowing into
19 trenches or other excavations. Sewer lines shall not be used for draining trenches, and the end of
20 all pipe and conduit shall be kept sealed and lines left clean and unobstructed during construction.
21 Only material suitable for backfilling shall be piled a sufficient distance from banks of trenches to
22 avoid overloading. Unsuitable backfill material shall be removed as directed by the Design
23 Architect/Engineer.
- 24 2. Sheathing and shoring shall be done as necessary for protection of work and personnel safety.
25 Unless otherwise indicated, excavation shall be open cut except for short sections. The
26 Contractor shall install geothermal marking (warning) tape 18 inches above all horizontal/header
27 piping.
- 28 3. Prior to drilling or trenching, the Contractor shall be responsible for reviewing the location of
29 underground utilities with the Owner's representative. Contractor shall arrange for utility
30 marking. Existing utility lines uncovered during excavation shall be protected from damage during
31 excavation and backfilling.
- 32 4. Stockpile and protect excavated material in area designated on site. Remove clean excess
33 material not being reused to location on site designated by Owner. Remove from site excess
34 excavated material not determined to be clean. Legally dispose of excess excavated material.
- 35 B. Excavation Requirements:
- 36 1. Underpin adjacent structures that will be damaged by excavation work, including utilities and pipe
37 chases.
- 38 2. Excavate subsoil required to accommodate site structures, construction operations, and other
39 work.
- 40 3. Machine slope banks to angle of repose or less, until shored.
- 41 4. Excavation cut not to interfere with normal 45 degree bearing splay of foundation, except where
42 excavation support system is used.

- 1 5. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- 2 6. Hand trim excavation. Remove loose matter.
- 3 7. Compaction should be 90% or higher.
- 4 8. Notify Architect/Engineer immediately of unexpected subsurface conditions.

5 **3.7 PIPE INSTALLATION**

- 6 A. The U-bend ends shall be sealed with fusion caps prior to insertion into the borehole. Reasonable care shall
7 be taken to ensure the geothermal loop field pipe is not crushed, kinked, or cut. Should any pipe be
8 damaged, the damaged section shall be cut out and the pipe reconnected by heat fusion.
- 9 B. The U-bend heat exchanger must be connected as indicated on the plans. The header design accounts for
10 balanced flow, as well as flushing and purging flow rates. No variations can be made in the circuit hookup
11 or the pipe sizes indicated. The minimum bend radius for each pipe size shall be 25 times the nominal pipe
12 diameter or the pipe manufacturer's recommendations, whichever is greater. The depth of all headers and
13 supply and return piping is indicated on the plans or must be maintained below the frost line.
- 14 C. Circuits shall be pressure tested before any backfilling of the header trenches is executed. The individual
15 circuits shall be pressure tested with water at 100 psig; however, not to exceed 150% of SDR 11 pipe
16 working pressure at bottom of vertical U-bend heat exchanger.

17 **3.8 TESTING AND CLEANING**

- 18 A. General Requirements:
 - 19 1. During installation, all trash, soil, small animals, and other organic material shall be kept out of the
20 pipe. Ends of the HDPE pipe shall be sealed until the pipe is joined to the circuits.
 - 21 2. The Contractor shall be responsible for correcting any problems and/or paying for any damage
22 caused by any debris left in the lines, after the flushing procedure has been completed, that enter
23 the building and plug strainers or otherwise negatively impact the performance of the building
24 systems.
- 25 B. Flushing and Purging:
 - 26 1. Before backfilling the trenches, all systems shall be flushed and purged of air and flow tested to
27 ensure all portions of the closed-loop ground heat exchanger are properly flowing. A portable
28 temporary purging unit shall be used.
 - 29 2. Each supply and return circuit shall be flushed and purged with a minimum water velocity of four
30 feet per second. Flush until clean, including removal of all cuttings, shavings, mud, sand, and
31 debris. The lines shall be left filled with clean water and then pressure tested. If connection to
32 the manifold is not immediate, piping must be capped.
 - 33 3. Utilizing the purging unit, conduct a pressure and flow test on the ground heat exchanger to
34 ensure the system is free of blockage. If the flow test indicates blockage, locate blockage using
35 manufacturer's recommendation, remove blockage, then re-purge and conduct the pressure and
36 flow test again until all portions of the system are flowing properly.
 - 37 4. Flushing and purging of piping shall occur in both directions.
- 38 C. Hydrostatic Testing:
 - 39 1. Fill and pressure test each piping circuit to 100 psig for four hours prior to the backfilling of the
40 trenches.

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 **1.6 WARRANTY**

2 A. Provide manufacturer's 24-month parts and labor warranty on the heat wheel against defects in material
3 and workmanship.

4 B. Provide manufacturer's 24 month parts and labor warranty on heat wheel drive belt and bearings against
5 defects in material and workmanship.

6 **1.7 MAINTENANCE SERVICE**

7 A. Include maintenance items as outlined in manufacturer's operating and maintenance data, including
8 minimum of belt replacement, and controls checkout, adjustments and recalibrations.

9 B. Submit copy of service call work order or report, and include description of work performed.

10 **PART 2 - PRODUCTS**

11 **2.1 ENERGY RECOVERY WHEEL**

12 A. Heat Wheel:

13 1. Wheel shall provide both sensible and latent heat recovery. Sensible and latent effectiveness shall
14 meet or exceed scheduled values.

15 2. The media shall be fluted, corrugated in design to minimize the leakage of the exhaust air to the
16 supply air through the media. The rotor media shall be coated with a polymer to avoid oxidation
17 and latent energy transfer. Silica gel and oxidized aluminum are not acceptable. All media
18 surfaces shall be coated with polymer prior to being formed into the fluted media structure.
19 Surfaces sprayed, dip coated, or polymers that must be reapplied over time are not acceptable.
20 Impregnated polymers in non-metallic substrates, such as paper, synthetic, plastic or glass fiber,
21 will not be acceptable. Wheels with polymer applied after wheel formation are not acceptable.
22 Wheels shall be treated for corrosion resistance to water moisture.

23 3. Energy recovery effectiveness values shall be tested in accordance with ASHRAE 84 and be AHRI
24 certified to Standard 1060 and bear the AHRI Certification symbol for AHRI Air-to-Air Energy
25 Recovery Ventilation Equipment Certification program based on AHRI 1060.

26 4. Seal: Heat wheel cassette shall be complete with face seal and perimeter seal to prevent cross
27 leakage between the two airstreams. Both seals shall be non-wearable to minimize leakage up to
28 specified differential pressure. Seals shall be adjustable.

29 5. Casing: Rotor casing shall limit the deflection of the rotor due to air pressure differential to less
30 than 1/32 inch at design differential pressure. Framing shall be galvanized steel, aluminum, or
31 other metal treated to be corrosion resistant to water moisture. Any exposed metal that is not
32 corrosion resistant to water moisture shall be painted with primer and corrosion-resistant paint.
33 Support rotor from bearings selected to support the rotating weight of the wheel. The bearings
34 shall be maintained or replaced without removal of the rotor from its casing or the media from its
35 spoke system.

36 6. Frame: The rotor frame shall be an industrial spoke system that provides the structural integrity
37 required at design pressure differentials. Wheel construction shall allow for post-fabrication
38 wheel alignment.

39 7. Drive: Rotor shall be driven from belt system and electric motor. Wheel shall be perimeter driven
40 with pulley sized properly for wheel size and rotation speed. Rotor belt shall have no field
41 adjustments required (0% stretch after initial tension). Provide motor with internal overload
42 protection.

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SECTION 23 73 13
INDOOR MODULAR AIR HANDLING UNITS

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Modular Indoor Air Handling Units.

6 **1.2 QUALITY ASSURANCE**

- 7 A. AHU Unit: Manufacturer specializing in design and manufacturing of the products specified in this section
8 with a minimum of five years' experience.
- 9 B. Fabrication: Conform to AMCA 99 and AHRI 430.
- 10 C. Fan Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- 11 D. Sound Ratings: Tested to AMCA 300.
- 12 E. Air Coils: Certify capacities, pressure drops, and selection procedures per AHRI 410.
- 13 F. Electrical control wiring shall be in accordance with NEC codes and ETL requirements.
- 14 G. Unit shall contain only UL listed components.
- 15 H. Conform to ASHRAE 90.1.
- 16 I. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion
17 into the airstream when tested at design airflow and with no airflow, using the rain test apparatus
18 described in Section 58 of UL 1995.

19 **1.3 SUBMITTALS**

- 20 A. Submit shop drawings per Section 23 05 00. Indicate ratings, fan performance, motor electrical
21 characteristics, gauges, material finishes, assembly, unit dimensions, weight loading, required clearances,
22 construction details, and field connection details.

23 1. Product Data

- 24 a. Provide fan curves with specified operating point clearly plotted. Select fans using
25 external static pressure noted in the schedule. Manufacturer responsible for calculation
26 of internal static pressure. Manufacturer shall include an allowance for clean filters in
27 the internal static pressure. An allowance for the difference between dirty filters and
28 clean filters is included in the external static. Submit static pressure calculations showing
29 total pressure drops, including tabulated internal pressure drops and specified external
30 static pressure drops
- 31 b. Submit sound power level data for both fan outlet and casing radiation at rated
32 capacity.
- 33 c. Submit shop drawings indicating coil and frame configurations, dimensions, materials,
34 rows, connections, and rough-in dimensions
- 35 d. Submit manufacturer's data showing that coil capacities, pressure drops, and selection
36 procedures meet or exceed specified requirements.

- 1 e. Provide a copy of data of filter media, filter performance data, filter assembly, and filter
2 frames with unit submittal for reference only.
- 3 B. Submit manufacturer's installation instructions.
- 4 C. Refer to Division 01 specification for substitution request procedures.
- 5 D. Any exceptions to the specifications must be clearly noted to the Architect/Engineer prior to acceptance.
6 Contractor is responsible for all expenses due to exceptions.
- 7 E. Submit operation and maintenance data. Include instructions for lubrication, filter replacement, motor and
8 drive replacement, and spare parts lists.

9 **1.4 EXTRA STOCK**

- 10 A. Provide clean filters in all units at time of installation.
- 11 B. Provide clean filters in all units at project final completion after all interior finishes are complete.
- 12 C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

13 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 14 A. Deliver products to site with protective coverings in-place. Loose shipped items must be in factory-provided
15 protective coverings, with factory-installed shipping skids and lifting lugs.
- 16 B. Store unit in clean dry place and protect from weather and construction traffic. Handle carefully to avoid
17 damage to components, enclosures, and finish.

18 **1.6 WARRANTY**

- 19 A. Provide a manufacturer's 1-year parts and labor warranty against defects in material and workmanship.

20 **1.7 GENERAL DESCRIPTION**

- 21 A. Unit Location:

22 1. The unit will be set on a concrete housekeeping pad by the Contractor.

- 23 B. Unit Description:

24 1. The unit shall contain all the components described in these specifications and shown on the
25 drawings and schedules.

26 2. Refer to air handling unit drawings and schedules for additional information

27 **PART 2 - PRODUCTS**

28 **2.1 MODULAR INDOOR AIR HANDLING UNITS**

- 29 A. Acceptable Manufacturers

- 30 1. Daikin
31 2. Carrier
32 3. Johnson Controls
33 4. Ventrol – ITF Indoor Unit

- 1 B. Housing:
- 2 1. WALL/ROOF CONSTRUCTION
- 3 a. Construct walls and roof from 2" thick double wall panel assemblies. Panels shall be
4 injected with polyurethane foam insulation and shall have a minimum thermal
5 conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90
6 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized steel with
7 gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or
8 G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently
9 applied bulb-type gaskets and able to be removed without affecting the integrity of
10 casing structure.
- 11 b. Under 55°F supply air temperature and design conditions on the exterior of the unit of
12 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The
13 AHU manufacturer shall provide tested casing thermal performance for the scheduled
14 supply air temperature plotted on a psychrometric chart. The design condition on the
15 exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not
16 available, AHU manufacturer shall provide, in writing, a guarantee against condensation
17 forming on the unit exterior at the stated design conditions above. The guarantee shall
18 note that the AHU manufacturer will cover all expenses associated with modifying or
19 replacing units should external condensate form on them.
- 20 c. Wall/Roof panel deflection shall not exceed L/240 ratio at a maximum +/- 5 inches of
21 static pressure. Deflection shall be measured at the midpoint of the panel.
- 22 2. FLOOR CONSTRUCTION
- 23 a. Construct floors from 2" thick double wall panel assemblies. Panels shall be injected
24 with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of
25 at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with
26 baked enamel or mill galvanized finish or G40 galvanized steel with gardobond finish.
27 The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel
28 with gardobond finish. Panels shall be gasketed with permanently applied bulb-type
29 gaskets.
- 30 b. Under 55°F supply air temperature and design conditions on the exterior of the unit of
31 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The
32 AHU manufacturer shall provide tested casing thermal performance for the scheduled
33 supply air temperature plotted on a psychrometric chart. The design condition on the
34 exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not
35 available, AHU manufacturer shall provide, in writing, a guarantee against condensation
36 forming on the unit exterior at the stated design conditions above. The guarantee shall
37 note that the AHU manufacturer will cover all expenses associated with modifying or
38 replacing units should external condensate form on them.
- 39 c. Floor panel deflection shall not exceed L/240 ratio based upon a 300 lb concentrated
40 load at the mid-span of the panel.
- 41 3. A full perimeter base rail shall be installed at each air handling unit. The base rail shall be
42 constructed from a minimum of 16 gauge G90 galvanized steel and shall be at least 6" high.
43 Panels shall be able to be removed without affecting the integrity of casing structure.
- 44 4. Install a stainless steel drain pan under each cooling coil meeting requirements as outlined in
45 ASHRAE 62.1. Extend drain pans the entire width of each coil, including piping and header if in the
46 air stream, and from the upstream face of each coil to a distance 1/2 of the vertical coil height
47 downstream from the downstream face. Pitch drain pans in two directions towards the outlet,
48 with a slope of at least 1/8" per foot.

- 1 5. Provide internal wiring for the installation of the lights and power in fan sections. Wiring for the
2 lights and receptacles in should be provided to a single point inlet power connection.
- 3 C. Doors:
- 4 1. Unit doors shall be double wall and insulated with the same materials used in the surrounding
5 unit walls.
- 6 2. Doors shall contain a continuous neoprene bulb type gasket.
- 7 3. Each door shall contain a double pane tempered, reinforced or safety glass window.
- 8 4. Each door shall have a minimum of two (2) high compression type latches, operable from both
9 sides.
- 10 5. Provide minimum 12" x 18" hinged access doors on both sides of the fan housing.
- 11 D. Access Sections:
- 12 1. Provide access sections as shown on the drawings between unit sections. Provide access doors as
13 shown on plans.
- 14 E. Fan:
- 15 1. Double width, double inlet, airfoil centrifugal.
- 16 2. Fan RPM shall not exceed 110% of scheduled value with the scheduled wheel type.
- 17 3. Statically and dynamically balanced.
- 18 4. Grease lubricated ball bearings, selected for 200,000 hours L-50 life at the design operating
19 conditions.
- 20 5. Provide extended lubrication lines for all bearings to an easily accessible location.
- 21 6. Factory balanced fans will be used with variable speed controls to operate at all speeds up to the
22 design speed.
- 23 7. Fan(s) shall have internal spring isolators.
- 24 F. Motors and Drives:
- 25 1. Motors shall have slide rails, adjusting screws, anchor bolts and bedplates.
- 26 2. Motor mounting bracket shall be adjustable to allow tightening of belts.
- 27 3. Motors shall be TEFC type with grease lubricated bearings.
- 28 4. Motors shall be "variable frequency drive rated" when controlled by VFDs. Refer to Section
29 23 05 13.
- 30 5. No equipment shall be selected or operate above 90% of its motor nameplate rating.
- 31 G. Enthalpy Wheel:
- 32 1. Refer to specification section 23 72 00 for requirements.

- 1 H. Coils
- 2 1. Glycol Water Coils:
- 3 a. Extended surface type with seamless copper tubes and continuous plate type aluminum
4 fins.
- 5 b. Suitable for continuous operation at 200 psi. Maximum air velocity of 1000 fpm.
- 6 c. Galvanized steel casing. Coil headers and U-bends shall not be exposed.
- 7 d. AHRI rated with 0.0005 fouling factor.
- 8 e. Size coils sized based on EWT, EAT, gpm and cfm as scheduled. LAT shall be at least as
9 high as scheduled. APD and WPD shall not exceed scheduled values.
- 10 f. Maximum 144 fins per foot.
- 11 g. Coils shall have drain and vent connections at supply and return headers with valves.
12 Extend valving outside of the unit casing.
- 13 h. Install coils level to allow drainage.
- 14 i. Minimum 0.024" tube wall thickness.
- 15 j. Acceptable Manufacturers: York/JCI, Carrier, Marlo, Daikin/McQuay, Heatcraft, or
16 American Air Filter.
- 17 2. Direct Expansion Coils:
- 18 a. Extended surface type with seamless copper tubes and continuous plate type aluminum
19 fins.
- 20 b. Galvanized steel casing.
- 21 c. Suitable for 250 psig. Maximum air velocity of 500 fpm.
- 22 d. AHRI rated for direct expansion use with R-22.
- 23 e. Size coils based on saturated suction temperature, EAT and cfm scheduled. The leaving
24 DB and APD shall not exceed the scheduled values.
- 25 f. Maximum 144 fins per foot. No water carryover shall occur at design airflow and no
26 anti-carryover coating shall be used.
- 27 g. All coils shall be split row or intertwined configuration.
- 28 h. Minimum 0.016" tube wall thickness.
- 29 i. Acceptable Manufacturers: York/JCI, Heatcraft, or Daikin/McQuay.
- 30 3. ELECTRIC COILS
- 31 a. Assembly: ANSI/UL 1096 listed and labeled, with terminal control box and hinged cover,
32 splice box, coil, casing, and controls.
- 33 b. Coil: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic
34 support bushings.

- 1 c. Casing: Die formed channel frame of 18 gauge galvanized steel with 3/8-inch mounting
2 holes on 6-inch centers. Provide tube supports for coils longer than 36-inches.
- 3 d. Controls: Automatic reset thermal cut-out, built-in magnetic contactors, control circuit
4 transformer and fuse, manual reset thermal cut-out, airflow proving device,
5 supplementary fusing for heaters over 48 amps, fused disconnect, solid-state control
6 with built-in zero-cross switching silicone controlled rectifier (SCR) and field installed
7 thermostat.
- 8 I. Mixing and Filter Section
- 9 1. Provide an angle filter section for 4" thick filters. Maximum filter velocity shall not exceed
10 specified value. Provide full size hinged access doors.
- 11 2. Reference Section 23 40 00 for filter requirements.

12 **PART 3 - EXECUTION**

13 **3.1 INSTALLATION**

- 14 A. General Installation Requirements
- 15 1. Install per manufacturer's instructions.
- 16 2. During construction provide temporary closures of metal or taped polyethylene over openings
17 into housing ducts to prevent dust from entering ductwork.
- 18 3. Seal all contractor installed penetrations airtight. Seal all openings prior to cleaning. Seal holes
19 with proper SMACNA closures conforming to pressure class of the housing.
- 20 4. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are
21 in place, bearings lubricated, and fan has been test run under observation.
- 22 B. Coil Requirements:
- 23 1. Comb all coils to repair bent fins.
- 24 2. Extend coil drain and vent connections to outside unit housing. Provide normally closed valve on
25 drain and vent connection outside of unit housing.

26 **END OF SECTION**

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SECTION 23 81 45
VARIABLE REFRIGERANT FLOW HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Variable refrigerant flow split system heat pump (heat/cool).
- B. Variable refrigerant flow split system heat pump with heat recovery (simultaneous heat/cool).

1.2 REFERENCES

- A. ANSI/AHRI 210/240 – Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment.
- B. ANSI/AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. ANSI/ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.
- D. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- E. MIL-H-22547B - Heat Pump, Heating and Cooling (Unitary).

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Indicate water, drain, and electrical rough-in connections on shop drawings or product data.
- C. Submit manufacturer's installation instructions.
- D. Submit manufacturer's warranty information.
- E. Submit installing contractor's manufacturer training certification.
- F. Submit refrigerant charge. Charge calculation should be based on installed piping lengths and equipment capacities.
- G. VRF Piping Layout Drawings:
 - 1. Submit detailed VRF piping layout drawings at 1/8" = 1'-0" minimum scale complete with the following information:
 - a. Actual pipe routing, fittings, hanger and support types, accessories, etc. with lengths and refrigerant charge noted.
 - b. Include insulation thickness and type of insulation.
 - c. Room names and numbers, ceiling types, and ceiling heights.
 - d. Indicate location of all beams, bar joists, etc., along with bottom of steel elevations, for each member.

- 1 2. Submit VRF piping and equipment layout drawings. Verify clearances and interferences with other
2 trades prior to preparing drawings. IMEG will provide electronic copies of piping drawings for
3 Contractor's use if the Contractor signs and returns an "Electronic File Transfer" waiver provided by
4 IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative
5 for this submittal. Submittals shall be in accordance with Section 23 05 00.
- 6 H. Submit Controls Diagrams:
- 7 1. Wiring diagrams and layouts for each control panel showing all termination numbers.
- 8 2. Schematic diagrams for all control, communication, and power wiring. Provide a schematic drawing
9 of the central system installation. Show all interface wiring to the control system.
- 10 3. Schematic diagrams for all field sensors and controllers.
- 11 4. A schematic diagram of each controlled system. The schematics shall have all control points labeled.
12 The schematics shall graphically show the location of all control elements in the system.
- 13 5. A schematic wiring diagram for each controlled system. Each schematic shall have all elements
14 labeled. Label all terminals.
- 15 6. All installation details and any other details required to demonstrate that the system will function
16 properly.
- 17 7. All interface requirements with other systems.
- 18 I. Sequences: Submit a complete description of the operation of the control system, including sequences of
19 operation. The description shall include and reference a schematic diagram of the controlled system. **The**
20 **wording of the control sequences in the submittal shall match verbatim that included in the construction**
21 **documents to ensure there are no sequence deviations from that intended by the Architect/Engineer.**
22 **Clearly highlight any deviations from the specified sequences on the submittals.**
- 23 J. Control System Demonstration and Acceptance: Provide a description of the proposed process, along with all
24 reports and checklists to be used.
- 25 K. Clearly identify work by others in the submittal.
- 26 L. Quantities of items submitted may be reviewed but are the responsibility of the Contractor to verify.
- 27 **1.4 DELIVERY STORAGE AND HANDLING**
- 28 A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation
29 and providing temporary covers after installation.
- 30 **1.5 OPERATION AND MAINTENANCE DATA**
- 31 A. Submit operation and maintenance data.
- 32 B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and
33 maintenance and repair data.
- 34 **1.6 WARRANTY**
- 35 A. Installing contractor shall perform tasks required by manufacturer to ensure maximum available warranty is
36 achieved. This will include but is not limited to:
- 37 1. System design performed by manufacturer certified designer.

- 1 2. System installation performed by manufacturer certified installer.
- 2 3. Complete system commissioning paperwork and submit to manufacturer.

- 3 B. Provide minimum five (5) year manufacturer's parts warranty (one-year basic warranty plus four-year
- 4 extended warranty) on all parts (excluding compressors) and one (1) year labor warranty.

- 5 C. Provide minimum five (5) year manufacturer's compressor parts warranty.

- 6 D. Contractor shall provide one (1) year parts and labor warranty on the associated controls system, including
- 7 all devices, wiring, and programming.

8 **1.7 DEMONSTRATION**

- 9 A. Engage manufacturer or factory-authorized service representative to train Owner's maintenance personnel
- 10 to adjust, operate, and maintain individual units and complete system.

11 **PART 2 - PRODUCTS:**

12 **2.1 ACCEPTABLE MANUFACTURERS**

- 13 A. Mitsubishi
- 14 B. Daikin AC
- 15 C. LG
- 16 D. Samsung

17 **2.2 SYSTEM DESCRIPTION**

- 18 A. The variable capacity, heat recovery, heat pump air conditioning system shall be a variable refrigerant flow
- 19 split system. The system shall consist of multiple evaporators using PID control and inverter driven outdoor
- 20 unit. The unit shall consist of direct expansion (DX), air-cooled heat pump air conditioning system, and
- 21 variable speed driven compressor multi zone split system.

- 22 B. Outdoor Unit - General: The outdoor unit is designed specifically for use with the manufacturer's components:

- 23 1. Refrigerant: R410A.

- 24 2. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and
- 25 refrigerant control. The refrigeration circuit of the outdoor unit shall consist of a compressor,
- 26 motors, fans, condenser coil, electronic expansion valves, oil separators, service ports, liquid
- 27 receivers, and accumulators.

- 28 3. All refrigerant lines shall be individually insulated between the outdoor and indoor units.

- 29 4. The connection ratio of the nominal capacity of indoor units to outdoor unit shall be 50-130%.

- 30 5. The sound pressure shall be no greater than 63 dBA at 4 feet from the outdoor unit at full load at
- 31 fan height.

- 32 6. The system shall automatically restart operation after a power failure and shall not cause any
- 33 settings to be lost, thus eliminating the need for re-programming.

- 34 7. The following safety devices shall be included on the outdoor unit: high pressure switch, control
- 35 circuit fuses, crankcase heaters, fusible plug, high pressure switch, overload relay, inverter overload
- 36 protector, thermal protectors for compressor and fan motors, over current protection for the
- 37 inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to
- 38 the various indoor units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle
- 39 shall be automatic as required to maintain oil levels at the outdoor unit.

- 1 8. The outdoor unit shall have water cooled heat exchange coils constructed from copper tubing with
2 aluminum fins.
- 3 9. The outdoor unit shall have at least one inverter controlled compressor and at least one high
4 efficiency constant speed compressor, depending on scheduled capacity. The system shall use a
5 control sequence to ensure that indoor loads are matched to the compressor capacity control.
- 6 10. The unit shall be rated for geothermal water applications with low water temperatures. Unit shall
7 include flow switch and controls output for modulating heat pressure control.
- 8 11. The refrigeration process of the outdoor unit will be maintained by pressure and temperature
9 sensors controlling solenoid valves, check valves, and bypass valves. The heating or cooling mode
10 of the outdoor unit will be controlled using a combination of 2 and 3-way valves that shall reverse
11 the cycle of the refrigerant to change the mode of the outdoor unit.
- 12 12. Unit Cabinet: The outdoor unit model shall be completely weatherproof and corrosion resistant.
13 The outdoor unit shall be constructed from steel plate and treated with an anti-corrosive paint.
- 14 13. Compressor:
- 15 a. The variable speed compressor shall be capable of changing the speed to follow the
16 variations in total cooling load as determined by the suction gas pressure as measured in
17 the outdoor unit.
- 18 b. The inverter driven compressor in each outdoor unit shall be DC, hermetically sealed,
19 scroll type.
- 20 c. The capacity control range shall be a minimum of 20% to 100% of total capacity.
- 21 d. Oil separators shall be standard with the equipment, together with an oil balancing circuit.
- 22 e. The compressor shall be mounted to avoid the transmission of vibration.
- 23 C. Branch Circuit Controllers:
- 24 1. The unit shall be constructed from galvanized steel plate and be internally insulated with
25 polyurethane foam. The connection to the system shall be either via brazed connection or flare
26 nuts.
- 27 2. The unit shall be connected to the indoor units or group of indoor units via its own dedicated
28 connection. This connection shall supply power and control signals to the solenoid valves in the
29 unit.
- 30 3. The unit shall have integral controls and be factory assembled, wired, and piped.
- 31 4. The unit shall include an integral drain pan and condensate pump as required.
- 32 5. The unit electrical power shall be 208-230V/1-phase/60Hz or as noted on the drawings.
- 33 6. Provide unit with at least two (2) additional unused connections for future expansion and
34 maintenance. Provide isolation valves and caps on unused connections.
- 35 D. Oil Recovery System:
- 36 1. System shall be equipped with an oil recovery system to ensure stable operation with long
37 refrigerant piping.

- 1 2. System shall be designed for proper oil return to compressor, along with distribution of oil to
2 individual compressor.
- 3 E. Indoor Units:
- 4 1. General – Each indoor unit shall have a heat exchanger that shall be constructed from copper tubing
5 with aluminum fins. The flow of refrigerant through the heat exchanger shall be controlled by an
6 electronic modulating expansion valve. This valve shall be controlled by internal temperature
7 sensors and shall be capable of controlling the variable capacity of the indoor unit between at least
8 25% and 100%. The units shall be shipped from the factory fully charged with dehydrated air.
- 9 2. Wall Mounted:
- 10 a. The indoor units shall be designed for installation onto a wall within a conditioned space
11 to be connected to a heat pump outdoor unit.
- 12 b. Acoustic Performance: The indoor units’ sound pressure shall not exceed 35 dBA at low
13 speed measured at 3.3 feet from the units.
- 14 c. Construction:
- 15 1) The indoor units shall be completely factory assembled and tested. Included in
16 each unit is factory wiring, piping, electronic modulating expansion valve,
17 control circuit board, fan motor thermal protector, flare connections,
18 condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused
19 time delay, and test run switch. Each unit shall have at least one auto-swing
20 louver for efficient air distribution, which closes automatically when the unit
21 stops. The remote controller shall be able to set five (5) steps of discharge
22 louver angle. The front grille shall be easily removed for washing. The discharge
23 angle shall automatically set at the same angle as the previous operation upon
24 restart. The condensate drain pipe shall be able to be connected to either left
25 or right sides.
- 26 d. The indoor units shall be equipped with a return air thermistor.
- 27 e. The indoor unit shall be separately powered.
- 28 f. Unit Cabinet:
- 29 1) The cabinet shall be affixed to a factory supplied wall mounting template and
30 located in the conditioned space.
- 31 2) The cabinet shall be constructed of molded plastic cover with sound absorbing
32 foamed polystyrene and polyethylene insulation.
- 33 g. Fan:
- 34 1) The fan shall be a direct-drive cross-flow type, statically and dynamically
35 balanced with high and low fan speeds available.
- 36 2) The fan motor shall be thermally protected.
- 37 h. Filter: The return air shall be filtered by means of a washable long-life filter with mildew
38 proof resin.

- 1 i. Coils:
- 2 1) Coils shall be of the direct expansion type, constructed from copper tubes
3 expanded into aluminum fins to form a mechanical bond.
- 4 2) The refrigerant connections shall be flare connections and the condensate shall
5 be coordinated with piping material specified in Section 23 21 00.
- 6 3) A condensate pump with at least 18 inches lift shall be located below the coil in
7 the condensate pan, with a built-in high-level safety alarm to shut down the
8 unit.
- 9 4) A thermistor shall be located on the liquid and gas line.
- 10 3. Ceiling Concealed Ducted (Low Static Pressure):
- 11 a. The indoor unit shall be a built-in ceiling concealed indoor unit, low static pressure (LSP),
12 for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel
13 casing to be connected to a heat pump outdoor unit. The indoor unit shall be
14 manufactured for ducted horizontal discharge air, with ducted horizontal return air or
15 bottom return air configuration (as scheduled or shown on the drawings). The external
16 static pressure shall be as scheduled on the drawings.
- 17 b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low
18 speed 5 feet from the unit.
- 19 c. Construction:
- 20 1) The indoor unit shall be completely factory assembled and tested. The unit shall
21 include factory wiring, piping, electronic modulating expansion valve, control
22 circuit board, fan motor thermal protector, flare connections, condensate drain
23 pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute
24 fused time delay, and test run switch.
- 25 2) The indoor units shall be equipped with a return air thermistor.
- 26 3) The indoor unit shall be separately powered.
- 27 4) The switch box shall be reached from the side or bottom for ease of service and
28 maintenance.
- 29 d. Unit Cabinet:
- 30 1) The cabinet shall be in the ceiling and ducted to the supply and return openings.
- 31 2) The cabinet shall be constructed with sound absorbing foamed polystyrene and
32 polyethylene insulation.
- 33 e. Fan:
- 34 1) The fan shall be direct-drive type, with statically and dynamically balanced
35 impeller with high and low fan speeds.
- 36 2) The fan motor shall be thermally protected.
- 37 f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew
38 proof resin.

- 1 g. Coils:
- 2 1) Coils shall be of the direct expansion type, constructed from copper tubes
3 expanded into aluminum fins to form a mechanical bond.
- 4 2) The refrigerant connections shall be flare connections, and the condensate shall
5 be coordinated with piping material specified in Section 23 21 00.
- 6 3) A condensate pump with at least 18 inches of lift shall be located below the coil
7 in the condensate pan, with a built-in high-level safety alarm to shut down the
8 unit.
- 9 4) A thermistor shall be located on the liquid and gas line.
- 10 4. Ceiling Concealed Ducted (High Static Pressure):
- 11 a. The indoor unit shall be a built-in ceiling concealed indoor unit, high static pressure (HSP),
12 for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel
13 casing to be connected to a heat pump outdoor unit. The indoor unit shall be
14 manufactured for ducted horizontal discharge air, with ducted horizontal return air or
15 bottom return air configuration (as scheduled or shown on the drawings). The external
16 static pressure shall be as scheduled on the drawings.
- 17 b. Acoustic Performance: The indoor units' sound pressure shall not exceed 31 dBA at low
18 speed 5 feet from the unit.
- 19 c. Construction:
- 20 1) The indoor unit shall be completely factory assembled and tested. The unit shall
21 include factory wiring, piping, electronic modulating expansion valve, control
22 circuit board, fan motor thermal protector, flare connections, condensate drain
23 pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute
24 fused time delay, and test run switch.
- 25 2) The indoor units shall be equipped with a return air thermistor.
- 26 3) The indoor unit shall be separately powered.
- 27 4) The switch box shall be reached from the side or bottom for ease of service and
28 maintenance.
- 29 d. Unit Cabinet:
- 30 1) The cabinet shall be in the ceiling and ducted to the supply and return openings.
- 31 2) The cabinet shall be constructed with sound absorbing foamed polystyrene and
32 polyethylene insulation.
- 33 3) The cabinet shall be factory insulated for use in unconditioned indoor spaces.
- 34 e. Fan:
- 35 1) The fan shall be direct-drive type, with statically and dynamically balanced
36 impeller with high and low fan speeds.
- 37 2) The fan motor shall be thermally protected.

- 1 f. Filter: The return air shall be filtered by means of a washable long-life filter with mildew
2 proof resin.
- 3 g. Coils:
- 4 1) Coils shall be of the direct expansion type, constructed from copper tubes
5 expanded into aluminum fins to form a mechanical bond.
- 6 2) The refrigerant connections shall be flare connections, and the condensate shall
7 be coordinated with piping material specified in Section 23 21 00.
- 8 3) A condensate pump with at least 18 inches of lift shall be located below the coil
9 in the condensate pan, with a built-in high-level safety alarm to shut down the
10 unit.
- 11 4) A thermistor shall be located on the liquid and gas line.

12 **2.3 PIPING**

- 13 A. Design Pressure: 450 psig.
- 14 1. Maximum Design Temperature: 250 F.
- 15 B. Piping - 4" and under.
- 16 1. Tubing: Type ACR hard drawn seamless copper tube, ASTM B280. Sizes indicated are nominal
17 designation.
- 18 2. Joints: Brazed with silver solder.
- 19 3. Fittings: Wrought copper solder joint, ANSI B16.22.
- 20 4. Special Requirements: All tubing shall be cleaned, dehydrated, pressurized with dry nitrogen,
21 plugged and tagged by manufacturer "for refrigeration service". During brazing operations,
22 continuously purge the interior of the pipe with nitrogen to prevent oxide formation.
- 23 C. Insulation:
- 24 1. Refer to 23 07 00 for requirements.

25 **PART 3 - CONTROLS**

26 **3.1 GENERAL**

- 27 A. The unit shall have controls provided with the unit by the manufacturer to perform input functions necessary
28 to operate the system.
- 29 B. Computerized PID control shall be used to maintain room temperature within 1°F of setpoint.
- 30 C. The unit shall be equipped with a programmable drying cycle that dehumidifies while inhibiting changes in
31 room temperature.
- 32 D. The indoor circuit board shall be wired to enable auxiliary heating when at least one of the following occurs:
- 33 1. Coil thermistor temperature drops below a factory setpoint in heating mode.
34 2. Outdoor temperature drops below setpoint (adj.).
35 3. Based on a user adjustable schedule.

1 **3.2 CENTRAL CONTROLLER – TYPE D**

2 A. This controller shall be wall mounted and hard wired, either directly to the control system or via gateway. It
3 shall be manufactured in ABS plastic with an LCD touchscreen display and shall be the manufacturer's
4 standard color. The controller shall be capable of individually controlling the following functions on at least
5 128 indoor units:

- 6 1. On/off
- 7 2. Operating mode
- 8 3. Setpoint
- 9 4. Fan speed
- 10 5. Louver position
- 11 6. Timer settings
- 12 7. Test run

13 B. The controller shall also be capable of displaying the following information individually for at least 128 indoor
14 units:

- 15 1. On/off
- 16 2. Operating mode
- 17 3. Setpoint
- 18 4. Fan speed
- 19 5. Louver position
- 20 6. Timer settings
- 21 7. Test run
- 22 8. Fault diagnosis

23 C. Each central controller unit can be accessed either locally or remotely via standard internet software. The
24 central controller will be able to indicate system alarms via volt free contacts and System Integration, as well
25 as providing control points for other devices. Additionally, the central controller shall be able to monitor
26 individual usage of heating and cooling demands, report alarm and conditions to nominated email address,
27 and enable remote alteration of systems setpoints to registered users. All required software costs and
28 licensing fees shall be included for the life of the systems.

29 **3.3 MAINTENANCE ACCESS**

- 30 A. Provide all gateways and connection cabling for performing maintenance functions on system.
- 31 B. Provide all software and registration codes as required to allow access into advanced maintenance functions.

32 **3.4 SYSTEM INTEGRATION**

- 33 A. The manufacturer's control system shall be capable of integrating with the building automation system with
34 built in hardware or separate add-on interfaces. All additional devices shall be provided by the manufacturer.
- 35 B. The system shall be compatible with BACnet®. Refer to Section 23 09 00.
- 36 C. System shall have remote capability through BACnet interface or a web browser interface. Last command
37 should overwrite previous commands. Basis of Design Mitsubishi AE-50A.

38 **PART 4 - EXECUTION**

39 **4.1 INSTALLATION**

- 40 A. Install in accordance with manufacturer's instructions. Install all piping, fittings, and insulation to meet
41 manufacturer's requirements. Install units level and plumb. Evaporator fan components shall be installed

- 1 using manufacturer's standard mounting devices securely fastened to building structure. Install and connect
2 refrigerant tubing and fittings.
- 3 B. Installing contractor shall attend manufacturer sponsored training to obtain installation certification.
- 4 C. Installer shall supply isolation ball valves for zoned refrigerant isolation. Installer shall supply isolation ball
5 valves with Schrader connection for isolating refrigerant charge and evacuation at each connected indoor
6 unit and outdoor unit. Isolation ball valves, with Schrader connection, are required for instances of indoor
7 unit isolation for troubleshooting, repair, or replacement without affecting the remainder of the system.
8 Isolation ball valves with Schrader connection are also required at outdoor unit connection to isolate unit for
9 troubleshooting, repair, or replacement and as required to provide partial capacity heating/cooling in the
10 instance of a failure of one of the multiple outdoor unit compressors.
- 11 D. Insulate all refrigerant pipes between the outdoor and indoor units. This includes the liquid pipe, the suction
12 pipe, the hot gas pipe, and the high/low pressure gas pipe. All fittings, valves, and specialty refrigerant
13 components in the piping between the indoor and outdoor units shall also be insulated. The insulation shall
14 have a continuous vapor barrier and shall pass through hangers and supports unbroken. Over size hangers
15 and supports to allow the insulation to pass through unbroken. Refer to 23 07 00 for additional requirements.
- 16 E. Engage manufacturer or factory-authorized service representative to perform startup service. Manufacturer
17 shall provide on-site startup and commissioning assistance through job completion. Complete installation and
18 startup checks according to manufacturer's written instructions.
- 19 F. Fully charge system with refrigerant per manufacturer's requirements.
- 20 G. Field Quality Control:
- 21 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-
22 assembled components and equipment installation, including connections, and to assist in field
23 testing.
- 24 2. Perform the following field tests and inspections, and prepare test reports:
- 25 a. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until
26 no leaks exist.
- 27 b. Operational Test: After electrical circuitry has been energized, start units to confirm
28 proper motor rotation and unit operation.
- 29 c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and
30 equipment.
- 31 H. Coordinate installation of units with architectural and electrical work. Coordinate installation of ceiling
32 recessed units with ceiling grid layout. Additional ceiling grid reinforcement or modification is the
33 responsibility of the Mechanical Contractor and shall be coordinated with the General Contractor.
- 34 I. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other
35 exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be
36 consistent with other wall-mounted devices. Height above finished floor shall not exceed 48".
- 37 J. Contractor is responsible for routing all condensate drains from all indoor equipment to a nearby floor drain
38 or standpipe. If ceiling heights or space finish does not accommodate gravity drainage, Contractor is
39 responsible for providing a condensate pump and all electrical work required.
- 40 K. Contractor is responsible for installing VRF heat pump control system. Contractor shall coordinate with the
41 Temperature Controls Contractor to determine extent of integration with building automation system (BAS).
42 Equipment that is required to integrate the VRF heat pump system with the BAS is the responsibility of the

1 VRF heat pump installing contractor. Final connections between VRF heat pump system and BAS shall be by
2 the Temperature Controls Contractor.

3 **END OF SECTION**

SECTION 23 81 46
PACKAGED WATER SOURCE HEAT PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water – to - Refrigerant.

1.2 QUALITY ASSURANCE

- A. Fan Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
- B. Fabrication: Conform to AMCA 99, ARI 320 and /or ARI 340.
- C. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
- D. Water Source Heat Pumps: Product of manufacturer regularly engaged in production of components who issue complete catalog data on total product.
- E. Conform to ASHRAE 90.1.

1.3 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 23 05 00.
- B. Shop drawings shall indicate assembly, unit dimensions, weight loading, required clearances, construction details, and field connection details.
- C. Product and data shall indicate capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.
- D. Provide fan curves with specified operating point clearly plotted.
- E. Submit manufacturer's installation instructions.

1.4 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.

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include instructions for lubrication, filter replacement, motor and drive replacement, and spare parts list.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until filters are in place, bearings lubricated, and fan has been test run under observation.

1 **1.7 WARRANTY**

2 A. Provide one (1) year manufacturer's warranty on all components of heat pump.

3 **PART 2 - PRODUCTS**

4 **2.1 ACCEPTABLE MANUFACTURERS**

- 5 A. Climatemaster
- 6 B. Aaon
- 7 C. Water Furnace
- 8 D. Florida Heat Pump
- 9 E. Approved Equal

10 **2.2 WATER – TO - REFRIGERANT**

11 A. General:

- 12 1. Equipment shall be completely factory assembled and tested, piped, internally wired, and fully
13 charged with R-410A. Field interface terminal strip and all safety controls shall be furnished and
14 factory installed.
- 15 2. Capacities shall be rated in accordance with ARI 320. Equipment shall be UL or ETL approved.
- 16 3. All water source heat pumps shall be high efficiency type and rated for geothermal water
17 applications with low water temperatures.
- 18 4. All units shall be factory run and tested for proper operation.
- 19 5. Unit shall include balancing valves, water flow switch, and two way head pressure control.

20 B. Housing:

- 21 1. 18-gauge steel construction with baked on enamel finish. 1/2", 1-1/2 lb. density interior insulation.
- 22 2. Access panels for compressor and control compartments.
- 23 3. Knockouts for entrance of line voltage and control wiring, all wiring connections shall be made
24 internal to the unit.
- 25 4. Supply and return water connections shall be FPT fittings and shall protrude through the cabinet
26 for connection to flexible hose.
- 27 5. Metal bracket, Isolators, and fasteners to suspend unit from building structure.
- 28 6. Unit size and capacity shall be as scheduled on the drawings.

29 C. Refrigerant Circuit:

- 30 1. Unit shall be ARI rated and ETL and CSA listed. Each unit shall be fully run tested at the factory with
31 a copy of the run test report furnished with operation and maintenance manuals.
- 32 2. Each unit shall have a sealed refrigerant circuit including digital scroll type hermetic compressors,
33 capillary expansion tubes, water to refrigerant coaxial heat exchanger and safety controls to include
34 low suction temperature, high and low pressure switches. Safety controls shall be resettable from
35 the main disconnect only.

- 1 3. Compressor shall be digital scroll type hermetic type, spring isolated for maximum sound and
2 vibration isolation, and have thermal overload protection.
- 3 4. UL listed coaxial heat exchanger constructed of copper inner tube and galvanized steel outer tube.
- 4 5. Unit shall accept time delay fuses or HACR circuit breaker for branch over-current protection.
- 5 6. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.
- 6 7. Unit shall include heat pump heating/cooling circuit plus hot gas reheat ability. Refer to mechanical
7 schedules for requirements.
- 8 D. Electrical:
- 9 1. Disconnect provided by Electrical Contractor.
- 10 2. Unit electrical characteristics shall be as scheduled on the drawings. Provide transformers as
11 required for control power.
- 12 E. Controls
- 13 1. Unit shall have a low-voltage terminal strip for hardwire connection to the DDC system. Unit shall
14 include internal safety controls for compressor short cycle protection, brown out protection, and
15 compressor time delay. The DDC system will control the unit operation as detailed on the
16 mechanical drawings.

17 **PART 3 - EXECUTION**

18 **3.1 INSTALLATION**

- 19 A. Install in accordance with manufacturer's instructions.
- 20 B. Protect units with protective cover during construction.

21 **3.2 CLEANING**

- 22 A. After construction is completed, including painting, clean exposed surfaces of units. Clean coils and inside of
23 units by vacuuming.

24 **END OF SECTION**

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**SECTION 23 82 00
TERMINAL HEAT TRANSFER UNITS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric Radiant Heaters.

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 ELECTRIC RADIANT HEATERS

A. Assembly: UL listed and labeled, with controls and terminal box with cover.

- 1 B. Heating Elements: Enclosed copper tube element of coiled nickel-chrome resistance wire centered in tubes
2 and embedded in refractory material, bonded to ceiling panel.
3 C. Ceiling Panels: 24" x 24" aluminum pans with silkscreened pattern matching ceiling tile.
4 D. Acceptable Manufacturers: Marley, Berko, Qmark, Chromalox, Markel.

5 **PART 3 - EXECUTION**

6 **3.1 INSTALLATION**

- 7 A. General Installation Requirements:
8 1. Install all products per manufacturers' instructions.
9 2. Coordinate recess sizes for recessed equipment.
10 3. Protect units with protective covers during construction.

11 **3.2 CLEANING**

- 12 A. After construction is complete, including painting, clean exposed surfaces of units. Vacuum clean coils and
13 inside of cabinets.
14 B. Touch-up marred or scratched surfaces of factory-finished cabinets, with materials furnished by
15 manufacturer.
16 C. Install new filters.

17 **END OF SECTION**

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 herein and within each specification section.

1.2 REFERENCES

A. NFPA 70 - National Electrical Code (NEC)

1.3 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 luminaires, 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.

- 1 D. Work Not Included:
- 2 1. Telecommunications cabling will be by others, in raceways and conduits furnished and installed as
3 part of the Electrical work.
- 4 2. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be
5 by other Contractors.

6 **1.4 OWNER FURNISHED PRODUCTS**

- 7 A. The Owner will supply manufacturer's installation data for new equipment purchased by owner for this
8 project.
- 9 B. This Contractor shall make all electrical system connections shown on the drawings or required for fully
10 functional units.
- 11 C. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

12 **1.5 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, AND CONTROL CONTRACTORS**

- 13 A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on
14 the contract document shall be sufficient for including said requirement in the project. The Prime Contractor
15 shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case
16 shall the project be assessed an additional cost for scope that is described on the contract documents on bid
17 day. The following division of responsibility is a guideline based on typical industry practice.
- 18 B. Definitions:
- 19 1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
- 20 2. "Technology Contractors" refers to the Contractors furnishing and installing systems listed in
21 Division 27/28 of this Specification.
- 22 3. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source
23 (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers
24 to, and including the connections to the terminals of the motor.
- 25 4. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of
26 magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of
27 devices in series with the motor power wiring. In the latter case, the devices are usually single
28 phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring
29 through a manual motor starter.
- 30 5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches,
31 relays, etc., generally represent the types of equipment associated with motor control wiring.
- 32 6. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the
33 same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control
34 transformer is usually used to give a control voltage of 120 volts.
- 35 7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper,
36 solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring
37 that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This
38 wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24
39 volt), in which case a control transformer shall be furnished as part of the temperature control
40 wiring.

- 1 8. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or
2 modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although
3 other voltages may be encountered.
- 4 9. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog
5 or digital signals between equipment.
- 6 10. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster
7 rings and other miscellaneous hardware required for the installation or mounting of
8 telecommunications/technology information outlets.
- 9 C. General:
- 10 1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors'
11 responsibilities related to electrical work required for items such as temperature controls,
12 mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of
13 the equipment cannot be determined until the systems have been selected and submittals
14 approved. Therefore, the electrical drawings show only known wiring related to such items. All
15 wiring not shown on the electrical drawings, but required for mechanical systems, is the
16 responsibility of the Mechanical Contractor.
- 17 2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the
18 Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The
19 Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical
20 Contractor and designate the terminal numbers for correct wiring.
- 21 3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays
22 required for the automatic control and/or interlock of motors and equipment, including final
23 connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and
24 installation to conform to Class 1 or 2 requirements, California Code of Regulation Title 24, Article
25 E725.
- 26 4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and
27 installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a
28 conflict arises, priority shall be as follows:
- 29 a. Luminaires.
30 b. Gravity flow piping, including steam and condensate.
31 c. Electrical bus duct.
32 d. Sheet metal.
33 e. Cable trays, including access space.
34 f. Other piping.
35 g. Conduits and wireway.
- 36 D. Mechanical Contractor's Responsibility:
- 37 1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
- 38 2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that
39 require wiring but are not shown on the electrical drawings or specified in the Electrical
40 Specification. If items such as relays, flow switches, or interlocks are required to make the
41 mechanical system function correctly or are required by the manufacturer, they are the
42 responsibility of the Mechanical Contractor.
- 43 3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is
44 a Subcontractor to the Mechanical Contractor.

- 1 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
2 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
3 determine a viable layout.
- 4 E. Temperature Control Contractor's or Subcontractor's Responsibility:
- 5 1. Wiring of all devices needed to make the Temperature Control System functional.
- 6 2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All
7 wiring required for the Control System, but not shown on the electrical drawings, is the
8 responsibility of the Temperature Control Contractor or Subcontractor.
- 9 3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical
10 Contractor, where wiring of the equipment is by the Electrical Contractor.
- 11 F. Electrical Contractor's Responsibility:
- 12 1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on
13 the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings
14 or Specifications.
- 15 2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or
16 Temperature Control Contractor when so noted on the Electrical Drawings.
- 17 3. Furnishes and installs motor control and temperature control wiring, when noted on the drawings.
- 18 4. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical
19 equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
- 20 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
21 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
22 determine a viable layout.
- 23 G. General (Electrical/Technology):
- 24 1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28
25 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be
26 furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of
27 Scope Responsibility".
- 28 2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work
29 responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and
30 Low Voltage Technology Wiring.
- 31 3. The exact wiring requirements for much of the equipment cannot be determined until the systems
32 have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways
33 and electrical power related to such items is shown on the Technology drawings. Other wiring,
34 conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but
35 required for operation of the systems is the responsibility of the Technology Contractor and
36 included in said Contractor's bid.
- 37 4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power
38 connections in support of Technology systems, the final installation shall not be until a coordination
39 meeting between the Electrical Contractor and the Technology Contractor has convened to
40 determine the exact location and requirements of the installation.

- 1 5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage
2 Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop
3 drawings by the Technology Contractor.
- 4 H. Technology Contractor's Responsibility:
- 5 1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable
6 support where open cable is specified.
- 7 2. Assumes all responsibility for all required backboxes, conduit and power connections not
8 specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested
9 Matrix of Scope Responsibility".
- 10 3. Assumes all responsibility for providing and installing all ladder rack and other cable management
11 hardware (as defined herein).
- 12 4. Responsible for providing the Electrical Contractor with the required grounding lugs or other
13 hardware for each piece of technology equipment which is required to be bonded to the
14 telecommunications ground bar.
- 15 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
16 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
17 determine a viable layout.

18 **1.6 COORDINATION DRAWINGS**

- 19 A. Definitions:
- 20 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the
21 sizes and locations, including elevations, of system components and required access areas to ensure
22 that no two objects will occupy the same space.
- 23 a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork,
24 fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and
25 steam condensate piping, and any item that may impact coordination with other
26 disciplines.
- 27 b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5"
28 and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting,
29 ceiling-mounted devices, and any item that may impact coordination with other
30 disciplines.
- 31 c. Technology trades shall include, but are not limited to, technology equipment, racks,
32 conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway,
33 ceiling-mounted devices, and any item that may impact coordination with other
34 disciplines.
- 35 d. Maintenance clearances and code-required dedicated space shall be included.
- 36 e. The coordination drawings shall include all underground, underfloor, in-floor, in chase,
37 and vertical trade items.
- 38 2. The contractors shall use the coordination process to identify the proper sequence of installation
39 of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated
40 end result, and to provide adequate access for service and maintenance.

- 1 B. Participation:
- 2 1. The contractors and subcontractors responsible for work defined above shall participate in the
3 coordination drawing process.
- 4 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a
5 complete set of composite electronic CAD coordination drawings that include all applicable trades,
6 and for coordinating the activities related to this process. The Coordinating Contractor for this
7 project shall be the Mechanical Contractor.
- 8 a. The Coordinating Contractor shall utilize personnel familiar with requirements of this
9 project and skilled as draftspersons/CAD operators, competent to prepare the required
10 coordination drawings.
- 11 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by
12 other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if
13 the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will
14 not consider blatant reproductions of original file copies an acceptable alternative for coordination
15 drawings.
- 16 C. Drawing Requirements:
- 17 1. The file format and file naming convention shall be coordinated with and agreed to by all
18 contractors participating in the coordination process and the Owner.
- 19 a. Scale of drawings:
- 20 1) General plans: 1/4 Inch = 1'-0" (minimum).
- 21 2) Mechanical, electrical, communication rooms, and including the surrounding
22 areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
- 23 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
- 24 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1
25 '-0" (minimum).
- 26 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
- 27 2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout
28 drawings shall be modified to accommodate other components as the coordination process
29 progresses.
- 30 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and
31 shafts.
- 32 4. The minimum quantity of drawings will be established at the first coordination meeting and sent to
33 the A/E for review. Additional drawings may be required if other areas of congestion are discovered
34 during the coordination process.
- 35 D. General:
- 36 1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E
37 will only review identified conflicts and give an opinion, but will not perform as a coordinator.
- 38 2. A plotted set of coordination drawings shall be available at the project site.
- 39 3. Coordination drawings are not shop drawings and shall not be submitted as such.

- 1 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for
2 each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material,
3 and labor to allow for adjustments in routing of utilities made necessary by the coordination process
4 and to provide a complete and functional system.
- 5 5. The contractors will not be allowed additional costs or time extensions due to participation in the
6 coordination process.
- 7 6. The contractors will not be allowed additional costs or time extensions for additional fittings,
8 reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the
9 drawings and determined necessary through the coordination process.
- 10 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts
11 or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
- 12 8. Changes to the contract documents that are necessary for systems installation and coordination
13 shall be brought to the attention of the A/E.
- 14 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated
15 on the drawings.
- 16 a. Access to mechanical, electrical, technology, and other items located above the ceiling
17 shall be through accessible lay-in ceiling tile areas.
- 18 b. Potential layout changes shall be made to avoid additional access panels.
- 19 c. Additional access panels shall not be allowed without written approval from the A/E at
20 the coordination drawing stage.
- 21 d. Providing additional access panels shall be considered after other alternatives are
22 reviewed and discarded by the A/E and the Owner's Representative.
- 23 e. When additional access panels are required, they shall be provided without additional
24 cost to the Owner.
- 25 10. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors
26 prior to installing any of the components.
- 27 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the
28 contractor or subcontractor who did not properly identify their work requirements, or installed
29 their work without proper coordination.
- 30 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

31 **1.7 QUALITY ASSURANCE**

- 32 A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:
- 33 1. The Contractor is responsible for constructing complete and operating systems. The Contractor
34 acknowledges and understands that the Contract Documents are a two-dimensional representation
35 of a three-dimensional object, subject to human interpretation. This representation may include
36 imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field
37 coordination items. Such deficiencies can be corrected when identified prior to ordering material
38 and starting installation. The Contractor agrees to carefully study and compare the individual
39 Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the
40 Contractor may discover. The Contractor further agrees to require each subcontractor to likewise
41 study the documents and report at once any deficiencies discovered.

- 1 2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding
2 any subcontracts, ordering material, or starting any work with the Contractor's own employees.
3 Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the
4 Contractor's risk.
- 5 B. Qualifications:
- 6 1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.
- 7 2. All Contractors and subcontractors shall employ only workmen who are skilled in their trades. At all
8 times, the number of apprentices at the job site shall be less than or equal to the number of
9 journeymen at the job site.
- 10 C. Compliance with Codes, Laws, Ordinances:
- 11 1. Conform to all requirements of the City of Madison Codes, Laws, Ordinances and other regulations
12 having jurisdiction.
- 13 2. If there is a discrepancy between the codes and regulations and these specifications, the
14 Architect/Engineer shall determine the method or equipment used.
- 15 3. If the Contractor notes, at the time of bidding, any parts of the drawings or specifications that do
16 not comply with the codes or regulations, he shall inform the Architect/Engineer in writing,
17 requesting a clarification. If there is insufficient time for this procedure, he shall submit with his
18 proposal a separate price to make the system comply with the codes and regulations.
- 19 4. All changes to the system made after the letting of the contract to comply with codes or the
20 requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
- 21 5. If there is a discrepancy between manufacturer's recommendations and these specifications, the
22 manufacturer's recommendations shall govern.
- 23 6. If there are no local codes having jurisdiction, the current issue of the NEC shall be followed.
- 24 D. Permits, Fees, Taxes, Inspections:
- 25 1. Procure all applicable permits and licenses.
- 26 2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where
27 the work is done, or as required by any duly constituted public authority.
- 28 3. The owner will pay all charges for permits or licenses. Refer to Division 0 for additional
29 requirements.
- 30 4. The owner will pay all fees and taxes imposed by State, Municipal, and other regulatory bodies.
- 31 5. Pay all charges arising out of required inspections by an authorized body.
- 32 6. Pay all charges arising out of required contract document reviews associated with the project and
33 as initiated by the Owner or authorized agency/consultant.
- 34 7. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's
35 Laboratories, Inc. or a nationally recognized testing organization.
- 36 8. Pay all telephone company charges related to the service or change in service.

- 1 E. Examination of Drawings:
- 2 1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of
3 the work and to indicate the general arrangements and locations of equipment, outlets, etc., and
4 the approximate sizes of equipment.
- 5 2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing
6 of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including,
7 but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined
8 by the Contractor unless noted in the contract documents.
- 9 3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
- 10 4. Where job conditions require reasonable changes in arrangements and locations, such changes
11 shall be made by the Contractor at no additional cost to the Owner.
- 12 5. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit
13 fittings, etc., may not be shown, but where required by other sections of the specifications or
14 required for proper installation of the work, such items shall be furnished and installed.
- 15 6. If an item is either shown on the drawings or called for in the specifications, it shall be included in
16 this contract.
- 17 7. The Contractor shall determine quantities and quality of material and equipment required from the
18 documents. Where discrepancies arise between drawings, schedules and/or specifications, the
19 greater and better-quality number shall govern.
- 20 8. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install"
21 shall mean connect up complete and ready for operation, and the word "provide" shall mean to
22 supply for use and connect up complete and ready for operation.
- 23 9. Any item listed as furnished shall also be installed unless otherwise noted.
- 24 10. Any item listed as installed shall also be furnished unless otherwise noted.
- 25 F. Electronic Media/Files:
- 26 1. Construction drawings for this project have been prepared utilizing Revit.
- 27 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or
28 copies of the specifications. Specifications will be provided in PDF format.
- 29 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic
30 File Transmittal" form provided by IMEG.
- 31 4. If the information requested includes floor plans prepared by others, the Contractor will be
32 responsible for obtaining approval from the appropriate Design Professional for use of that part of
33 the document.
- 34 5. The electronic contract documents can be used for preparation of shop drawings and as-built
35 drawings only. The information may not be used in whole or in part for any other project.
- 36 6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout
37 drawings or coordination drawings.
- 38 7. The use of these CAD documents by the Contractor does not relieve them from their responsibility
39 for coordination of work with other trades and verification of space available for the installation.

1 8. The information is provided to expedite the project and assist the Contractor with no guarantee by
2 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility
3 or liability for the Contractor's use of these documents.

4 G. Field Measurements:

5 1. Verify all pertinent dimensions at the job site before ordering any conduit, conductors, wireways,
6 bus duct, fittings, etc.

7 **1.8 SUBMITTALS**

8 A. Submittals shall be required for the following items, and for additional items where required elsewhere in the
9 specifications or on the drawings.

10 1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
26 05 73	Power System Study
26 09 33	Lighting Control System
26 24 16	Panelboards
26 24 19	Motor Control
26 27 26	Wiring Devices
26 28 16	Disconnect Switches
26 28 21	Contactors
26 43 00	Surge Protection Devices
26 51 00	Lighting
26 52 00	Emergency Lighting Equipment
28 31 00	Fire Alarm and Detection Systems

11 B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

12 1. Transmittal: Each transmittal shall include the following:

- 13 a. Date
- 14 b. Project title and number
- 15 c. Contractor's name and address
- 16 d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
- 17 e. Description of items submitted and relevant specification number
- 18 f. Notations of deviations from the contract documents
- 19 g. Other pertinent data

20 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:

- 21 a. Date
- 22 b. Project title and number
- 23 c. Architect/Engineer
- 24 d. Contractor and subcontractors' names and addresses
- 25 e. Supplier and manufacturer's names and addresses
- 26 f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
- 27 g. Description of item submitted (using project nomenclature) and relevant specification
28 number
- 29 h. Notations of deviations from the contract documents
- 30 i. Other pertinent data
- 31 j. Provide space for Contractor's review stamps

- 1 3. Composition:
- 2 a. Submittals shall be submitted using specification sections and the project nomenclature
- 3 for each item.
- 4 b. Individual submittal packages shall be prepared for items in each specification section. All
- 5 items within a single specification section shall be packaged together where possible. An
- 6 individual submittal may contain items from multiple specifications sections if the items
- 7 are intimately linked (e.g., pumps and motors).
- 8 c. All sets shall contain an index of the items enclosed with a general topic description on
- 9 the cover.
- 10 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings;
- 11 manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures;
- 12 performance and test data; wiring and control diagrams; dimensions; shipping and operating
- 13 weights; shipping splits; service clearances; and all other drawings and descriptive data of materials
- 14 of construction as may be required to show that the materials, equipment or systems and the
- 15 location thereof conform to the requirements of the contract documents.
- 16 5. Contractor's Approval Stamp:
- 17 a. The Contractor shall thoroughly review and approve all shop drawings before submitting
- 18 them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal
- 19 certifying it has been reviewed.
- 20 b. Unstamped submittals will be rejected.
- 21 c. The Contractor's review shall include, but not be limited to, verification of the following:
- 22 1) Only approved manufacturers are used.
- 23 2) Addenda items have been incorporated.
- 24 3) Catalog numbers and options match those specified.
- 25 4) Performance data matches that specified.
- 26 5) Electrical characteristics and loads match those specified.
- 27 6) Equipment connection locations, sizes, capacities, etc. have been coordinated
- 28 with other affected trades.
- 29 7) Dimensions and service clearances are suitable for the intended location.
- 30 8) Equipment dimensions are coordinated with support steel, housekeeping pads,
- 31 openings, etc.
- 32 9) Constructability issues are resolved (e.g., weights and dimensions are suitable
- 33 for getting the item into the building and into place, sinks fit into countertops,
- 34 etc.).
- 35 d. The Contractor shall review, stamp and approve all subcontractors' submittals as
- 36 described above.
- 37 e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the**
- 38 **Contractor's review of all material and a complete understanding of exactly what is to**
- 39 **be furnished. Contractor shall clearly mark all deviations from the contract documents**
- 40 **on all submittals. If deviations are not marked by the Contractor, then the item shall be**
- 41 **required to meet all drawing and specification requirements.**
- 42 6. Submittal Identification and Markings:
- 43 a. The Contractor shall clearly mark each item with the same nomenclature applied on the
- 44 drawings or in the specifications.

1 **1.10 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE**

2 A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent
3 damage.

4 B. Keep all materials clean, dry and free from damaging environments.

5 C. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the
6 Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment,
7 he/she shall contract with a qualified lifting and rigging service that has similar documented experience.
8 Follow all equipment lifting and support guidelines for handling and moving.

9 D. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site
10 prior to bid for path locations and any required building modifications to allow movement of equipment.
11 Contractor shall coordinate his/her work with other trades.

12 **1.11 NETWORK / INTERNET CONNECTED EQUIPMENT**

13 A. These specifications may require certain equipment or systems to have network, Internet and/or remote
14 access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as
15 a functional capability and is not to be construed as authority to connect or enable any Network Capability.
16 Network Capability may only be connected or enabled with the express written consent of the Owner.

17 **1.12 WARRANTY**

18 A. Refer to Division 1 specifications for requirements.

19 **1.13 INSURANCE**

20 A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

21 **1.14 MATERIAL SUBSTITUTION**

22 A. Refer to Division 1 specifications for requirements.

23 **1.15 LEED REQUIREMENTS**

24 A. This project is pursuing a LEED certification in accordance with USGBC LEED Rating System for New
25 Construction v4. The Contractor shall provide all services and documentation necessary to achieve this rating.

26 **1.16 PROJECT COMMISSIONING**

27 A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00, and provide
28 all services necessary for compliance with LEED Prerequisite EAp1, Fundamental Commissioning, and EAc3
29 Enhanced Commissioning.

30 **PART 2 - PRODUCTS**

31 **2.1 GENERAL**

32 A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors,
33 motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise
34 on drawings or elsewhere in specifications.

1 **PART 3 - EXECUTION**

2 **3.1 JOBSITE SAFETY**

3 A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or
4 his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other
5 entity of their obligations, duties and responsibilities including, but not limited to, construction means,
6 methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all
7 portions of the work of construction in accordance with the contract documents and any health or safety
8 precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no
9 authority to exercise any control over any construction contractor or other entity or their employees in
10 connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite
11 safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be
12 made additional insureds under the Contractor's general liability insurance policy.

13 **3.2 EXCAVATION, FILL, BACKFILL, COMPACTION**

14 A. General:

15 1. Prior to the commencement of any excavation or digging, the Contractor shall verify all
16 underground utilities with the regional utility locator. Provide prior notice to the locator before
17 excavations. Contact information for most regional utility locaters can be found by calling 811.

18 2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection
19 with his work.

20 B. Excavation:

21 1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.

22 2. If excavations are carried in error below indicated levels, concrete of same strength as specified for
23 the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer
24 shall be placed in such excess excavations under the foundation. Place thoroughly compacted,
25 clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.

26 3. Trim bottom and sides of excavations to grades required for foundations.

27 4. Protect excavations against frost and freezing.

28 5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not
29 undermine footing or foundation.

30 6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.

31 7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges
32 and assist in the surface restoration.

33 8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the
34 Architect/Engineer or their representative, and do no further work until the Architect/Engineer or
35 their representative gives further instructions.

36 9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall
37 visit the premises and determine the soil conditions by actual observations, borings, or other
38 means. The cost of all such inspections, borings, etc., shall be borne by the bidder.

39 10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel
40 shall be used to support the conduit unless masonry cradles or encasements are used.

- 1 11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of
2 masonry cradles or encasements is permitted, unless otherwise indicated on the electrical
3 drawings.
- 4 12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed
5 is permitted provided the excavation is made to a depth to permit installation of the cable on a fine
6 sand bed at least 3 inches deep.
- 7 C. Dewatering:
- 8 1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and
9 pits free of water.
- 10 D. Underground Obstructions:
- 11 1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of
12 construction are shown on the drawings. Review all Bid Documents for all trades on the project to
13 determine obstructions indicated. Take great care in making installations near underground
14 obstructions.
- 15 2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as
16 directed by the Architect/Engineer.
- 17 E. Fill and Backfilling:
- 18 1. No rubbish or waste material is permitted for fill or backfill.
- 19 2. Furnish all necessary sand for backfilling.
- 20 3. Dispose of the excess excavated earth as directed.
- 21 4. Backfill materials shall be suitable for required compaction, clean and free of perishable materials,
22 frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter.
23 Water is not permitted to rise in unbackfilled trenches.
- 24 5. Backfill all trenches and excavations immediately after installing of conduit, or removing forms,
25 unless other protection is directed.
- 26 6. Around piers and isolated foundations and structures, backfill and fill shall be placed and
27 consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and
28 backfill materials in 6" uniform horizontal layers with each layer compacted separately to required
29 density.
- 30 7. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3"
31 deep. Backfill around conduits with sand, in 6" layers and compact each layer.
- 32 8. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed
33 on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank
34 requirements.
- 35 9. Backfill with sand up to grade for all conduits under slabs or paved areas. All other conduits shall
36 have sand backfill to 6" above the top of the conduit.
- 37 10. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and
38 uniformly tamp each layer to eliminate lateral or vertical displacement.

- 1 11. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall
2 be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM
3 Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus
4 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
- 5 12. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the
6 backfill until a period of 48 hours has elapsed.
- 7 F. Surface Restoration:
- 8 1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored
9 to the original condition. Replace all planting and landscaping features removed or damaged to its
10 original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or
11 sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
- 12 2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged
13 shall be replaced with comparable materials and restored to original condition. Broken edges shall
14 be saw cut and repaired as directed by Architect/Engineer.
- 15 **3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK**
- 16 A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:
- 17 1. Placing fill over underground and underslab utilities.
- 18 2. Covering exterior walls, interior partitions and chases.
- 19 3. Installing hard or suspended ceilings and soffits.
- 20 B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring
21 correction. The contractor's schedule shall account for these reviews and show them as line items in the
22 approved schedule.
- 23 C. Above-Ceiling Final Observation:
- 24 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes,
25 but is not limited to:
- 26 a. All junction boxes are closed and identified in accordance with Section 26 05 53 Electrical
27 Identification.
- 28 b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and
29 operational.
- 30 c. Luminaire whips are supported above the ceiling.
- 31 d. Conduit identification is installed in accordance with Section 26 05 53 Electrical
32 Identification.
- 33 e. Luminaires are suspended independently of the ceiling system when required by these
34 contract documents.
- 35 f. All wall penetrations have been sealed.
- 36 2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall
37 review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling
38 Final Observation.

- 1 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this
2 review and prior to seven days elapsing, the Architect/Engineer may not recommend further
3 payments to the contractor until full access has been provided.
- 4 **3.4 PROJECT CLOSEOUT**
- 5 A. The following paragraphs supplement the requirements of Division 1.
- 6 B. Final Jobsite Observation:
- 7 1. To prevent the Final Jobsite Observation from occurring too early, the Contractor shall review the
8 completion status of the project and certify that the job is ready for the final jobsite observation.
- 9 2. Attached to the end of this section is a typical list of items that represent the degree of job
10 completeness expected prior to requesting a review. The Contractor shall sign the attached
11 certification and return it to the Architect/Engineer so that the final observation can be scheduled.
- 12 3. It is understood that if the Architect/Engineer finds the job not ready for the final observation and
13 additional trips and observations are required to bring the project to completion, the cost of the
14 additional time and expenses incurred by the Architect/Engineer will be deducted from the
15 Contractor's final payment.
- 16 4. Contractor shall notify Architect/Engineer 48 hours prior to installation of ceilings or lay-in ceiling
17 tiles.
- 18 C. The following must be submitted before Architect/Engineer recommends final payment:
- 19 1. Operation and maintenance manuals with copies of approved shop drawings.
- 20 2. Record documents including reproducible drawings and specifications.
- 21 3. A report documenting the instructions given to the Owner's representatives complete with the
22 number of hours spent in the instruction. The report shall bear the signature of an authorized agent
23 of this Contractor and shall be signed by the Owner's representatives.
- 24 4. Provide spare parts, maintenance, and extra materials in quantities specified in individual
25 specification sections. Deliver to project site and place in location as directed and submit receipt to
26 Architect/Engineer.
- 27 5. Inspection and testing report by the fire alarm system manufacturer.
- 28 6. Start-up reports on all equipment requiring a factory installation or start-up.
- 29 **3.5 OPERATION AND MAINTENANCE MANUALS**
- 30 A. Refer to Division 1 specifications for requirements.
- 31 **3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE**
- 32 A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the
33 complete systems installed under this contract.
- 34 B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care,
35 maintenance, and operation of the equipment and systems.
- 36 C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions
37 to facilitate this recording.

- 1 D. The instructions shall include:
- 2 1. Maintenance of equipment.
- 3 2. Start-up procedures for all major equipment.
- 4 3. Description of emergency system operation.
- 5 E. Notify the Architect/Engineer of the time and place for the verbal instructions to the Owner's representative
- 6 so his representative can be present if desired.
- 7 F. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual
- 8 specification section.
- 9 G. Operating Instructions:
- 10 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and
- 11 specialized systems.
- 12 2. If the Contractor does not have staff that can adequately provide the required instructions, he shall
- 13 include in his bid an adequate amount to reimburse the Owner for the Architect/Engineer to
- 14 perform these services.

15 **3.7 RECORD DOCUMENTS**

- 16 A. The following paragraphs supplement the requirements of Division 1.
- 17 B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes
- 18 made to the systems clearly and permanently marked in complete detail.
- 19 C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment
- 20 and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall
- 21 be marked on the documents. Record documents that merely reference the existence of the above items are
- 22 not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this
- 23 Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with
- 24 this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time
- 25 of work.
- 26 D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at
- 27 any normal work time.
- 28 E. Upon completing the job, and before final payment is made, give the marked-up drawings to the
- 29 Architect/Engineer. Refer to 01 78 39 for additional requirements.
- 30 F. Record actual routing of conduits exceeding 2 inches.

31 **3.8 PAINTING**

- 32 A. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match
- 33 original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall
- 34 have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- 35 B. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should
- 36 this Contractor install equipment in a finished area after the area has been painted, he shall have the
- 37 equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed
- 38 as described in project specifications.
- 39 C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces,
- 40 shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.

- 1 D. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish
2 coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify
3 with the Architect his color preference before ordering.
- 4 E. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms.
5 Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is
6 not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- 7 F. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as
8 equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the
9 Architect.
- 10 G. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where
11 conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.
- 12 H. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway
13 and equipment with the following:
- 14 1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish
15 with two coats of Alkyd base enamel paint.
- 16 2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.
- 17 I. In accordance with LEED EQc4.2: Low-Emitting Materials - Paints and Coatings, all paints and coatings used
18 on the interior of the building must comply with the following criteria:
- 19 1. Architectural paints and coatings applied to interior walls and ceilings must not exceed the volatile
20 organic compound (VOC) content limits established in Green Seal Standard GS-11, Paints, 1st
21 Edition, May 20, 1993.
- 22 2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates must not exceed the
23 VOC content limit of 250 g/L (2 lb./gal) established in Green Seal Standard GC-03, Anti-Corrosive
24 Paints, 2nd Edition, January 7, 1997.
- 25 **3.9 ADJUST AND CLEAN**
- 26 A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- 27 B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- 28 C. Remove all rubbish, debris, etc., accumulated during construction from the premises.
- 29 **3.10 SPECIAL REQUIREMENTS**
- 30 A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access
31 area for servicing.
- 32 B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location,
33 placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- 34 C. Installation of equipment or devices without regard to coordination of access requirements and confirmation
35 with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's
36 expense.

- 1 D. In accordance with LEED EQc4.1, Low-Emitting Materials - Adhesives and Sealants, all adhesives and sealants
2 used on the interior of the building must comply with the following requirements:
- 3 1. Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management
4 District (SCAQMD) Rule #1168.
- 5 2. Aerosol adhesives must comply with Green Seal Standard for Commercial Adhesives GS-36
6 requirements in effect on October 19, 2000.

7 **3.11 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION**

- 8 A. Within the limits of Construction:
- 9 1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.
- 10 2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the
11 contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1
12 and Division 21/22/23 of these specifications.
- 13 B. Outside the limits of Construction:
- 14 1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits
15 of construction.
- 16 2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of
17 these specifications.
- 18 3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's
19 IAQ representative.

20 **3.12 SYSTEM STARTING AND ADJUSTING**

- 21 A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to
22 obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration
23 and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and
24 final adjustments that may be needed.
- 25 B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment
26 operation and does not pose a danger to personnel or property.
- 27 C. All operating conditions and control sequences shall be tested during the start-up period. Testing all
28 interlocks, safety shut-downs, controls, and alarms.
- 29 D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all
30 systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting,
31 assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship
32 problems, equipment substitution issues or unsatisfactory system performance, including call backs during
33 the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and
34 materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the
35 services are requested. The Contractor shall pay the Owner for services required that are product, installation
36 or workmanship related. Payment is due within 30 days after services are rendered.

1 **3.13 FIELD QUALITY CONTROL**

2 A. General:

- 3 1. Conduct all tests required during and after construction. Submit test results in NETA format, or
4 equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test
5 conditions, humidity, conductor length, and results corrected to 40°C.
- 6 2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with
7 training in the proper testing techniques.
- 8 3. All cables and wires shall be tested for shorts and grounds following installation and connection to
9 devices. Replace shorted or grounded wires and cables.
- 10 4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live"
11 part, shall have all defective parts or materials replaced.
- 12 5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall
13 include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free
14 of short circuits and grounds and have an insulation value not less than NEC Standards. Take
15 readings between conductors, and between conductors and ground.
- 16 6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and
17 changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or
18 authority having jurisdiction deems necessary.

19 B. Other Equipment:

- 20 1. Give other equipment furnished and installed by the Contractor all standard tests normally made
21 to assure that the equipment is electrically sound, all connections properly made, phase rotation
22 correct, fuses and thermal elements suitable for protection against overloads, voltage complies
23 with equipment nameplate rating, and full load amperes are within equipment rating.

- 24 C. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat
25 the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

26 **3.14 CONSTRUCTION WASTE MANAGEMENT**

- 27 A. This Contractor shall comply with all construction and demolition waste disposal and recycling requirements
28 outlined in LEED MRc2: Construction Waste Management (follow latest edition at the time of bidding or as
29 referenced in these specifications).

- 30 1. This Contractor shall coordinate with the General Contractor to develop and implement a
31 construction waste management plan that, at a minimum, identifies the materials to be diverted
32 from disposal and whether the materials will be sorted on-site or co-mingled.

- 33 2. The Contractor shall track waste disposal and recycling efforts throughout the construction process
34 for all materials associated with this Contractor's scope of work. The Contractor shall provide this
35 information to the General Contractor so that it can be incorporated with similar information from
36 all other contractors for the project.

- 37 a. Calculations for waste and recycled material can be done by weight or volume, but they
38 must be consistent throughout the project. The Contractor shall coordinate with the
39 General Contractor to establish the preferred calculation method and report the results
40 accordingly.

- 41 b. Excavated soil and land-clearing debris do not count towards the waste disposal or
42 recycled material.

1 READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

2 To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the
3 project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical
4 list of items that represent the degree of job completeness expected prior to your requesting a final job observation.

- 5 1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
- 6 2. Electrical panels have typed circuit identification.
- 7 3. Smoke and fire/smoke dampers are wired and have been tested.
- 8 4. Per Section 26 05 00, cable insulation test results have been submitted.
- 9 5. Operation and Maintenance manuals have been submitted as per Section 26 05 00.
- 10 6. Bound copies of approved shop drawings have been submitted as per Section 26 05 00.
- 11 7. Report of instruction of Owner's representative has been submitted as per Section 26 05 00.
- 12 8. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
- 13 9. Start-up reports from factory representative have been submitted as per Section 26 05 00.

14 Accepted by:

15 Prime Contractor _____

16 By _____ Date _____

17 Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign
18 this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

19 It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and
20 observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time
21 and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

22 * * * * *

1
2
SECTION 26 05 03
THROUGH PENETRATION FIRESTOPPING

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Through-Penetration Firestopping.

6 **1.2 QUALITY ASSURANCE**

- 7 A. Manufacturer: Company specializing in manufacturing products specified in this Section.
8 B. Installer: Individuals performing work shall be certified by the manufacturer of the system selected for
9 installation.

10 **1.3 REFERENCES**

- 11 A. UL 263 - Fire Tests of Building Construction and Materials.
12 B. UL 723 - Surface Burning Characteristics of Building Materials
13 C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
14 D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
15 E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
16 F. Intertek / Warnock Hersey - Directory of Listed Products
17 G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
18 H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
19 I. The Building Officials and Code Administrators National Building Code
20 J. Wisconsin Administrative Code

21 **1.4 DELIVERY, STORAGE, AND HANDLING**

- 22 A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect
23 for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or
24 other causes. Follow manufacturer's instructions for storage.
25 B. Install material prior to expiration of product shelf life.

26 **1.5 PERFORMANCE REQUIREMENTS**

- 27 A. General: For penetrations through the following fire-resistance-rated constructions, including both empty
28 openings and openings containing penetrating items, provide through-penetration firestop systems that are
29 produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke
30 and other gases, and maintain original fire-resistance rating of construction penetrated.

- 31 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
32 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling
33 membranes of roof/ceiling assemblies.

- 34 B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL
35 1479:

- 36 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not
37 less than that equaling or exceeding fire-resistance rating of constructions penetrated.
38 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with
39 T-ratings indicated, as well as F-ratings:

- 40 a. Floor penetrations located outside wall cavities.

- | | | |
|----|-----|--|
| 1 | 2. | Hilti, Inc. |
| 2 | 3. | RectorSeal Corporation, Metacaulk |
| 3 | 4. | Tremco; Sealant/Weatherproofing Division |
| 4 | 5. | Johns-Manville |
| 5 | 6. | Specified Technologies Inc. (S.T.I.) |
| 6 | 7. | Spec Seal Firestop Products |
| 7 | 8. | AD Firebarrier Protection Systems |
| 8 | 9. | Wiremold/Legrand: FlameStopper |
| 9 | 10. | Dow Corning Corp |
| 10 | 11. | Fire Trak Corp |
| 11 | 12. | International Protective Coating Corp |

12 **2.2 THROUGH PENETRATION FIRESTOP SYSTEMS**

- 13 A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping
14 equal to time rating of construction being penetrated.
- 15 B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require
16 hazardous waste removal.
- 17 C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and
18 contraction.
- 19 D. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor
20 loading or traffic.
- 21 E. Provide firestopping systems allowing continuous insulation for all insulated pipes.
- 22 F. Provide firestopping systems classified by UL or listed by Intertek / Warnock Hersey for penetrations through
23 all fire rated construction. Firestopping systems shall be selected from the UL or listed by Intertek / Warnock
24 Hersey Fire Resistance Directory Category XHEZ based on substrate construction and penetrating item size
25 and material and shall fall within the range of numbers listed:
- 26 1. Combustible Framed Floors and Chase Walls - 1 or 2 Hour Rated
27 F Rating = Floor/Wall Rating
28 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
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

- 29 2. Non-Combustible Framed Walls - 1 or 2 Hour Rated
30 F Rating = Wall Rating
31 T Rating = 0

<u>Penetrating Item</u>	<u>UL System No.</u>
No Penetrating Item	WL 0000-0999*

<u>Penetrating Item</u>	<u>UL System No.</u>
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

- 1 3. Concrete or Masonry Floors and Walls - 1 or 2 Hour Rated
2 F Rating = Wall/Floor Rating
3 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

4 *Alternate method of firestopping is patching opening to match original rated construction.

5 G. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the
6 firestopping manufacturer.

7 H. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance
8 Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the
9 Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

10 **PART 3 - EXECUTION**

11 **3.1 EXAMINATION**

12 A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean
13 and repair surfaces as required. Remove laitance and form-release agents from concrete.

14 B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping
15 systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing
16 firestopping systems.

17 C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey
18 system substrate criteria.

19 D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer.
20 Confine primer to area of bond.

1 **3.2 INSTALLATION**

2 A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items.
3 Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall
4 consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate
5 method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped
6 immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock
7 Hersey listed firestopping system is installed.

8 B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock
9 Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.

10 C. Install dams as required to properly contain firestopping materials within openings and as required to achieve
11 required fire resistance rating. Remove combustible damming after appropriate curing.

12 **3.3 CLEANING AND PROTECTING**

13 A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials
14 that are approved in writing by through-penetration firestop system manufacturers and that do not cause
15 damage.

16 B. Provide final protection and maintain conditions during and after installation that ensure that through-
17 penetration firestop systems are without damage or deterioration at time of Substantial Completion. If,
18 despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-
19 penetration firestop systems immediately and install new materials to produce systems complying with
20 specified requirements.

21 **3.4 IDENTIFICATION**

22 A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system
23 supplier and contain the following information in a contrasting color:

24 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building
25 Management of Any Damage."

26 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed;
27 contractor name and phone number; manufacturer's representative name, address, and phone
28 number.

29 **3.5 INSPECTION**

30 A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.

31 B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their
32 request.

33 C. Proceed with enclosing through-penetration firestop system with other construction only after inspection
34 reports are issued and firestop installations comply with requirements.

35 D. The contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one)
36 to prove compliance with specifications and manufacturer's instructions and details. Destructive system
37 removal shall be performed by the contractor and witnessed by the Architect/Engineer and manufacturer's
38 factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations
39 will be reviewed. The contractor is responsible for all costs associated with this requirement including labor
40 and material for removing and replacing the installed firestop system. If any firestop system is found to not
41 be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive
42 review and replacement at the Architect/Engineer's discretion and the contractor's expense.

43 **END OF SECTION**

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**SECTION 26 05 13
WIRE AND CABLE**

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Building wire
- 6 B. Remote control and signal cable
- 7 C. Fire rated cable and assemblies
- 8 D. Healthcare facilities cable (HFC)
- 9 E. Armored cable (AC)
- 10 F. Metal-clad cable (MC)
- 11 G. Nonmetallic-sheathed cable (NM)

12 **1.2 RELATED WORK**

- 13 A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification
- 14 labeling requirements.

15 **1.3 REFERENCES**

- 16 A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- 17 B. NFPA 70 - National Electrical Code (NEC)
- 18 C. UL 44 – Thermoset-Insulated Wires and Cables
- 19 D. UL 83 – Thermoplastic-Insulated Wires and Cables
- 20 E. UL 854 – Service-Entrance Cables
- 21 F. UL 1581 – Standard for Electrical Wires, Cables, and Flexible Cords
- 22 G. UL 2196 – Fire Resistive, Fire Resistant and Circuit Integrity Cables

23 **PART 2 - PRODUCTS**

24 **2.1 BUILDING WIRE**

- 25 A. Feeders and Branch Circuits Larger Than 6 AWG: Copper, stranded conductor, 600-volt insulation, XHHW-2.
- 26 B. Feeders and Branch Circuits Larger Than 6 AWG in Underground Conduit: Copper, stranded conductor, 600-
- 27 volt insulation, XHHW-2.
- 28 C. Feeders and Branch Circuits 6 AWG and Smaller: Copper conductor, 600-volt insulation, THHN/THWN. 6 and
- 29 8 AWG, stranded conductor; smaller than 8 AWG, solid or stranded conductor, unless otherwise noted on the
- 30 drawings.
- 31 D. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded
- 32 conductor, unless otherwise noted on the drawings.
- 33 E. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.
- 34 F. Each 120 and 277-volt branch circuit shall have a dedicated neutral conductor. Neutral conductors shall be
- 35 considered current-carrying conductors for wire derating.

36 **2.2 REMOTE CONTROL AND SIGNAL CABLE**

- 37 A. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated
- 38 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket.

1 B. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation,
2 rated 60°C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

3 C. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation,
4 rated 60°C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed
5 for use in air handling ducts, hollow spaces used as ducts, and plenums.

6 **2.3 FIRE-RATED CABLE AND ASSEMBLIES**

7 A. Properties and requirements of fire rated cables and assemblies:

8 1. 2HR fire rated for horizontal and vertical installations.

9 B. Acceptable fire-rated cables and listed assemblies:

10 1. Mineral Insulated Cables: Copper conductor, 600-volt insulation, rated 90°C, Type MI.

11 **PART 3 - EXECUTION**

12 **3.1 WIRE AND CABLE INSTALLATION SCHEDULE**

13 A. Above Accessible Ceilings:

14 1. Building wire shall be installed in raceway.

15 B. All Other Locations: Building wire in raceway.

16 C. Above Grade: All conductors installed above grade shall be type "THHN".

17 D. Underground or In Slab: All conductors shall be type "THWN".

18 E. Low Voltage Cable (less than 100 volts): Low voltage cable shall be installed in raceway.

19 F. Fire-Rated 2-Hour Feeders and Circuit Requiring Continuous Operation (CI): Refer to Part 2 of this section for
20 acceptable products and assemblies. Installation shall meet UL 2196.

21 **3.2 WIRE FOR SPECIALIZED SYSTEMS**

22 A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these
23 specifications. If not designated on the drawings or specifications, the system manufacturer's
24 recommendations shall be followed:

- 25 1. Fire alarm
26 2. Low voltage switching
27 3. Sound
28 4. Electronic control
29 5. Security
30 6. TV
31 7. Telephone
32 8. Data
33 9. Clock

34 **3.3 CONTRACTOR CHANGES**

35 A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30°C, NEC
36 Table 310.16.

- 1 B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the
2 ampacity of the basis of design circuits, if he/she chooses to use methods or materials other than the basis of
3 design.
- 4 C. Underground electrical duct ampacity rating shall be in accordance with NEC Table B.310.15(B)(2)(7) or
5 calculated in accordance with Annex B Application Information for Ampacity Calculation. The calculations and
6 a sketch of the proposed installation shall be submitted prior to any conduit being installed.
- 7 D. Record drawing shall include the calculations and sketches.

8 **3.4 GENERAL WIRING METHODS**

- 9 A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control
10 wiring.
- 11 B. Use no wire smaller than 18 AWG for low voltage control wiring (<100 volts).
- 12 C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20
13 ampere, 277-volt branch circuit home runs longer than 200 feet.
- 14 D. Use no wire smaller than 8 AWG for outdoor lighting circuits.
- 15 E. The ampacity of multiple conductors in one conduit shall be derated per NEC 310. In no case shall more than
16 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor
17 control centers, etc.
- 18 F. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same
19 raceway or cable.
- 20 G. Splice only in junction or outlet boxes.
- 21 H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- 22 I. Make conductor lengths for parallel circuits equal.
- 23 J. All conductors shall be continuous in conduit from last outlet to their termination.
- 24 K. Terminate all spare conductors on terminal blocks, and label the spare conductors.
- 25 L. Cables or wires shall not be laid out on the ground before pulling.
- 26 M. Cables or wires shall not be dragged over earth or paving.
- 27 N. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage
28 to the wire and cable.
- 29 O. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other
30 devices.
- 31 P. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of
32 circuit is required, and insulated.

33 **3.5 WIRING INSTALLATION IN RACEWAYS**

- 34 A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and
35 larger wires.

- 1 B. Install wire in raceway after interior of building has been physically protected from the weather and all
2 mechanical work likely to injure conductors has been completed.
- 3 C. Pulling shall be continuous without unnecessary stops and starts with wire or cable only partially through
4 raceway.
- 5 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
6 enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a
7 minimum of change in the direction of the bend.
- 8 E. Conductors shall not be pulled through conduits until plastering or masonry work is completed and conduits
9 are free from moisture. Care shall be taken so that long pulls of wire or pulls around several bends are not
10 made where the wire may be permanently stretched and the insulation damaged.
- 11 F. Only nylon rope shall be permitted to pull cables into conduit and ducts.
- 12 G. Completely and thoroughly swab raceway system before installing conductors.
- 13 H. Conductor Supports in Vertical Raceways:
- 14 1. Support conductors in vertical raceways in accordance with NEC 300.19 and Table 300.19(A)
15 Spacing of Conductor Supports.
- 16 2. Supports shall be of insulated wedge type (OZ Gedney Type S, or equal) and installed in a tapered
17 insulated bushing fitting or a metal woven mesh with a support ring that fits inside conduit fitting
18 installed in an accessible junction box (Hubbell Kellems support grip or equal).

19 **3.6 CABLE INSTALLATION**

- 20 A. Provide protection for exposed cables where subject to damage.
- 21 B. Use suitable cable fittings and connectors.
- 22 C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the
23 routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or
24 less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown
25 diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in
26 accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of
27 Installation", recognized industry standards; and coordinated with other contractors.
- 28 D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings.
29 Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with
30 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables.
- 31 E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize
32 the ceiling support system for wire and cable support.
- 33 F. J-hook supports shall be installed at a maximum of five-foot (5') intervals. All J-hooks shall be installed where
34 completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be
35 independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal
36 separation and 6" vertical separation between systems.
- 37 G. Open cable shall only be installed where specifically shown on the drawings, or permitted in these
38 specifications.

39 **3.7 FIRE-RATED CABLE AND ASSEMBLY INSTRUCTIONS**

- 40 A. Terminations of the fire-rated cable must be outside of the fire zone.

1 B. Fire-rated cable shall be installed according to the manufacturer's instructions, recommendations, and UL
2 listing.

3 C. Route fire-rated cable and assemblies separate from other feeders and distribution. Install cable and
4 assemblies in locations protected from physical damage.

5 D. Refer to Electrical Identification Section 26 05 53 for specific identification requirements.

6 **3.8 WIRING CONNECTIONS AND TERMINATIONS**

7 A. Splice and tap only in accessible junction boxes.

8 B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for
9 conductor terminations, 8 AWG and larger.

10 C. Use solderless, tin-plated, compression terminals (lugs) applied with indenter crimp for copper conductor
11 terminations, 10 AWG and smaller.

12 D. Use solderless pressure connectors with insulating covers for copper wire splices and taps, 8 AWG and
13 smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.

14 E. Use compression connectors applied with circumferential crimp for conductor splices and taps, 6 AWG and
15 larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value
16 of conductor.

17 F. Thoroughly clean wires before installing lugs and connectors.

18 G. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature
19 rise.

20 H. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the
21 time sequence in which the phase conductors so identified reach positive maximum voltage.

22 I. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the
23 connections to phase conductors are intended thus:

24 1. Facing the front and operating side of the equipment, the phase identification shall be:

- 25 a. Left to Right - A-B-C
26 b. Top to Bottom - A-B-C

27 J. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of
28 the starters or disconnect switches.

29 **3.9 FIELD QUALITY CONTROL**

30 A. Field inspection and testing will be performed under provisions of Division 1.

31 B. Building Wire and Power Cable Testing: Perform an insulation-resistance test on each conductor with respect
32 to ground and adjacent conductors. Test shall be made by means of a low-resistance ohmmeter, such as a
33 "Megger". The applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt
34 rated cable. The test duration shall be one minute. Insulation resistance must be greater than 100 mega-ohm
35 for 600 volt and 25 mega-ohm for 300 volt rated cables per NETA Acceptance Testing Standard. Verify uniform
36 resistance of parallel conductors.

37 C. MI cable shall have the insulation resistance of each cable tested with a 500-volt dc megohmmeter prior to
38 energizing the cables. Tabulate resistance values and submit to Architect/Engineer for acceptance.

- 1 D. Inspect wire and cable for physical damage and proper connection.
- 2 E. Torque test conductor connections and terminations to manufacturer's recommended values.
- 3 F. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing
4 connections.
- 5 G. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to
6 tightening of lugs shall be provided.
- 7 H. Protection of wire and cable from foreign materials:
- 8 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign
9 material application or contact with any wire or cable type. Foreign material is defined as any
10 material that would negatively impact the validity of the manufacturer's performance warranty.
11 This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound,
12 or any other surface chemical, liquid, or compound that could come in contact with the cable, cable
13 jacket, or cable termination components.
- 14 I. Overspray of paint on any wire or cable will not be accepted. It shall be the Contractor's responsibility to
15 replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of
16 the cables with harsh chemicals is not allowed.

17 **END OF SECTION**

SECTION 26 05 26
GROUNDING AND BONDING

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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.

1.3 REFERENCES

- A. NFPA 70 – National Electrical Code (NEC)

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.
- D. Grounding Electrode Conductors: Stranded cable.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Sizes and types below are typical. Adjust to suit Project conditions and requirements.
- G. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch 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.

- 1 H. **[GB]:** Grounding Bus:
- 2 1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4" x 2", length of
3 electrical room.
- 4 I. **[IBT]:** Intersystem Bonding Termination:
- 5 1. Copper bar, 1/4" x 2" x 24". Provide with wall mounting brackets, insulators and pre-tapped holes.
- 6 2. Approved Manufacturers: Harger GBI Series, Erico B544 Series.

7 **2.2 CONNECTOR PRODUCTS**

- 8 A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected
9 items.
- 10 B. Connectors: Hydraulic compression type or exothermic-welded type, in kit form, and selected per
11 manufacturer's written instructions.
- 12 C. Bolted Connectors: Bolted-pressure-type connectors.

13 **PART 3 - EXECUTION**

14 **3.1 CONNECTIONS**

- 15 A. General Make connections so galvanic action or electrolysis possibility is minimized. Select connectors,
16 connection hardware, conductors, and connection methods so metals in direct contact will be galvanically
17 compatible.
- 18 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact
19 points closer to order of galvanic series.
- 20 2. Make connections with clean, bare metal at points of contact.
- 21 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
- 22 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical
23 clamps.
- 24 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration
25 of moisture to contact surfaces.
- 26 B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up
27 or that show convex surfaces indicating improper cleaning are not acceptable.
- 28 C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure
29 for compression connectors. Use tools and dies recommended by connector manufacturer. Provide
30 embossing die code or other standard method to make a visible indication that a connector has been
31 adequately compressed on grounding conductor.
- 32 D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs.
33 No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

- 1 E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without
2 mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect
3 grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond
4 electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding
5 conductors, unless otherwise indicated.
- 6 F. Structural Steel Connection: Exothermic-welded connections to structural steel. Coordinate with structure to
7 provide physical protection.
- 8 G. Connections at Test Wells: Use compression-type connectors on conductors and make two bolted- and
9 clamped-type connections between conductors and ground rods.
- 10 H. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's
11 published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in
12 UL 486A.
- 13 I. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses,
14 insulate entire area of connection and seal against moisture penetration of insulation and cable.

15 **3.2 INSTALLATION**

- 16 A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth,
17 concrete, masonry, crushed stone, and similar materials.
- 18 B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid
19 obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each
20 grounding conductor that passes through a below grade wall must be provided with a waterstop.
- 21 C. Grounding electrode conductor (GEC) shall be protected from physical damage by rigid polyvinyl chloride
22 conduit (PVC) in exposed locations.
- 23 D. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and
24 supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor
25 locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to
26 the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible
27 for maintenance.
- 28 E. In raceways, use insulated equipment grounding conductors.
- 29 F. Underground Grounding Conductors: Use copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches
30 below grade or bury 12 inches above duct bank when installed as part of the duct bank.
- 31 G. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment,
32 below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

33 **3.3 EQUIPMENT GROUNDING SYSTEM**

- 34 A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless
35 specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- 36 B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or
37 bus.

38 **3.4 BONDING SYSTEM**

- 39 A. At building expansion joints, provide flexible bonding jumpers to connect to columns or beams on each side
40 of the expansion joint.

- 1 B. Isolated Equipment Enclosure: For designated equipment supplied by a branch circuit or feeder, isolate
2 equipment enclosure from supply raceway with a nonmetallic raceway fitting listed for the purpose. Install
3 fitting where raceway enters enclosure, and install a separate equipment bonding conductor.
- 4 C. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible
5 grounding conductors.
- 6 D. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding
7 conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater
8 units, piping, well casing, connected equipment, and components.
- 9 E. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged
10 piping at street side of flange. Provide bonding jumper around water meter.
- 11 F. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems,
12 provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to
13 each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack
14 conductor at terminal board.
- 15 G. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a
16 1/4-by-2-by-12-inch grounding bar.
- 17 H. Terminal Cabinets: Terminate bonding conductor on cabinet grounding terminal.
- 18 I. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version
19 of the National Electric Code.

20 **3.5 CONCRETE OR WOOD BUILDING GROUNDING SYSTEM**

- 21 A. Provide a copper common grounding electrode conductor for the attachment of multiple separately derived
22 systems in accordance with NEC 250.30(A)(4)(a) through 250.30(A)(4)(c). Individual grounding conductor taps
23 from the separately derived systems to the common grounding electrode shall be sized in accordance with
24 NEC 250.66. All tap connections shall be made in an accessible location in such a manner that common
25 grounding electrode conductor remains without a splice or joint.

26 **3.6 FIELD QUALITY CONTROL**

- 27 A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

28 **END OF SECTION**

SECTION 26 05 27
SUPPORTING DEVICES

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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: 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.

- 1 6. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements
2 and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the
3 type and size of attachment devices used.
- 4 7. Concrete Anchors: Fasten to concrete using cast-in or post-installed anchors designed per the
5 requirements of Appendix D of ACI 318-08. Post-installed anchors shall be qualified for use in
6 cracked concrete by ACI-355.2.
- 7 8. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping
8 masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors
9 designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated
10 fasteners, wooden plugs, or plastic inserts.
- 11 D. Conduit Sleeves and Lintels:
- 12 1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings
13 required for the Contractor's work in masonry walls and conduit sleeves for floors, unless
14 specifically shown as being by others.
- 15 2. Refer to Structural plans and specifications for lintel requirements and sizes.
- 16 3. Fabricate all lintels from structural steel shapes or as indicated on the drawings. All lintels and
17 grouped wall openings shall be approved by the Architect or Structural Engineer.
- 18 4. Fabricate all sleeves from standard weight black steel pipe. Provide continuous sleeve. Cut or split
19 sleeves are not acceptable. Sleeves through concrete walls may be high density polyethylene pipe
20 penetration sleeve with a water stop collar, suitable for use with Link-Seal mechanical seals.
21 Century-Line Model CS.
- 22 5. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared
23 ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to
24 accept spring closing floor plates.
- 25 6. Sleeves shall not penetrate structural members without approval from the Structural Engineer.
- 26 7. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth
27 finish with sufficient annular space around material passing through opening so slight settling will
28 not place stress on the material or building structure.
- 29 8. Install all sleeves concentric with conduits. Secure sleeves in concrete to wood forms. This
30 Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- 31 9. Where conduits rise through concrete floors that are on earthen grade, provide 3/4" resilient
32 expansion joint material (asphalt and cork) wrapped around the pipe, the full depth of concrete, at
33 the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- 34 10. Size sleeves large enough to allow expansion and contraction movement.
- 35 E. Concrete Housekeeping Pads:
- 36 1. Concrete bases for all floor mounted equipment and wall mounted equipment which is surface
37 mounted and extends to within 6" of the finished floor, unless shown otherwise on the drawings,
38 shall be 3-1/2" thick concrete.
- 39 2. Bases shall extend 3" on all sides of the equipment (6" larger than factory base).
- 40 3. Where the base is less than 12" from a wall, the base shall be carried to the wall to prevent a "dirt-
41 trap".

- 1 4. Concrete materials and workmanship required for the Contractor's work shall be provided by him.
2 Materials and workmanship shall conform to the applicable standards of the Portland Cement
3 Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000
4 pounds compression per square inch at twenty-eight days.
- 5 F. Rooftop Support System:
- 6 1. Provide pre-fabricated roof supports for all conduit and equipment installed above the roof.
7 Support all conduit and equipment a minimum of 4" above roof.
- 8 2. Support system shall be compatible with single ply, bituminous, metal, and spray foam roof
9 systems. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent
10 ponding of water in the support.
- 11 3. All metal components shall be hot dipped galvanized. Mounting hardware shall be stainless steel or
12 hot dipped galvanized. Support shall be UV, corrosion, and freeze/thaw resistant. Support shall
13 include orange paint, reflective safety orange accents, or similar markings for increased visibility.
- 14 4. Acceptable Products: Anvil International HBS-Base Series, Cooper B-Line Dura-Blok, Erico Caddy
15 Pyramid 50, 150, 300, or 600 (to match load).

16 **PART 3 - EXECUTION**

17 **3.1 INSTALLATION**

- 18 A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion
19 anchors in concrete and beam clamps on structural steel.
- 20 B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls;
21 expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on
22 concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- 23 C. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless
24 otherwise noted.
- 25 D. Do not use powder-actuated anchors without specific permission.
- 26 E. Do not drill structural steel members.
- 27 F. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat
28 appearance. Use hexagon head bolts with spring lock washers under all nuts.
- 29 G. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment
30 on concrete pads.
- 31 H. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing
32 in stud walls for rigid mounting.
- 33 I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- 34 J. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof
35 decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and
36 mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off
37 steel framing will need to be added.
- 38 K. Refer to Section 26 05 33 for special conduit supporting requirements.

1 **3.2 FINISH**

2 A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and above
3 suspended ceiling spaces are not considered exposed.

4 B. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of
5 support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings.
6 Smooth ends and install elastomeric insulation with two coats of latex paint if exposed steel is within 6'-6" of
7 finish floor and presents potential injury to personnel.

8 **END OF SECTION**

**SECTION 26 05 33
CONDUIT AND BOXES**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metallic conduit and fittings (RMC)
- B. Intermediate metallic conduit and fittings (IMC)
- C. Electrical metallic tubing and fittings (EMT)
- D. Flexible metallic conduit and fittings (FMC)
- E. Liquidtight flexible metallic conduit and fittings (LFMC)
- F. Rigid polyvinyl chloride conduit and fittings (PVC)
- G. High density polyethylene conduit and fittings (HDPE)
- H. Wall and ceiling outlet boxes
- I. Electrical connection
- J. Pull and junction boxes
- K. Rough-ins
- L. Handholes
- M. Accessories

1.2 RELATED WORK

- A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 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)

- 1 F. Underwriters Laboratories (UL): Applicable Listings
- 2 1. UL 1 – Flexible Metal Conduit
- 3 2. UL 6 – Rigid Metal Conduit
- 4 3. UL 360 – Liquid Tight Flexible Steel Conduit
- 5 4. UL514-B – Conduit Tubing and Cable Fittings
- 6 5. UL651-A – Type EB and a PVC Conduit and HDPE Conduit
- 7 6. UL651-B – Continuous Length HDPE Conduit
- 8 7. UL746A – Standard for Polymeric Materials – Short Term Property Evaluations
- 9 8. UL797 – Electrical Metal Tubing
- 10 9. UL1242 – Intermediate Metal Conduit
- 11 G. American Standard of Testing and Materials (ASTM):
- 12 1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
- 13 2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
- 14 3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in
- 15 the Edge Wise Position
- 16 4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of
- 17 Plastic Pipe by Parallel-Plate Loading
- 18 5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based
- 19 on Outside Diameter
- 20 6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material
- 21 H. Definitions:
- 22 1. Fittings: Conduit connection or coupling.
- 23 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
- 24 3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the
- 25 primary use is to house service equipment and to route services. These spaces generally have
- 26 exposed structures, bare concrete and non-architecturally emphasized finishes.
- 27 4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public.
- 28 These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
- 29 5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in
- 30 the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.
- 31 6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an
- 32 elevation below the finished grade shall be considered above grade but a wall retaining earth shall
- 33 be considered below grade.
- 34 7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

35 **PART 2 - PRODUCTS**

36 **2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS**

- 37 A. Acceptable Manufacturers:
- 38 1. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved
- 39 equal.
- 40 2. Acceptable Manufacturers of RMC Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline,
- 41 Raco, Bridgeport, Midwest, Regal, Thomas & Betts, Crouse-Hinds, Killark, or approved equal.

- 1 B. Minimum Size Galvanized Steel: 3/4 inch (19mm), unless otherwise noted.
- 2 C. Fittings and Conduit Bodies:
- 3 1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for
4 mounting to form.
- 5 2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of
6 movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
- 7 3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless
8 steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
- 9 4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting
10 insulation. Where required elsewhere in the contract documents, bushing shall be complete with
11 ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not**
12 **acceptable.**
- 13 5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.
- 14 D. PVC Externally Coated Conduit: Compliant with UL 6, ANSI C80.1 and NEMA RN 1; rigid galvanized steel
15 conduit with external 40 mil PVC coating and internal 2 mil urethane coating surface. All fittings and conduit
16 bodies shall be complete with coating. Threads shall be hot galvanized and coated with a clear coat of
17 urethane. The PVC coated system shall include necessary PVC coated fittings, boxes and covers to form a
18 complete encapsulated system. Acceptable Manufacturers: Robroy, T&B Ocal or approved equal.

19 **2.2 INTERMEDIATE METALLIC CONDUIT (IMC) AND FITTINGS**

- 20 A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.
- 21 B. Acceptable Manufacturers: Allied, LTV, Steelduct, Wheatland Tube Co, O-Z Gedney, or approved equal.
- 22 C. Fittings and Conduit Bodies:
- 23 1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for
24 mounting to form.
- 25 2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of
26 movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
- 27 3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless
28 steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.
- 29 4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting
30 insulation. Where required elsewhere in the contract documents, bushing shall be complete with
31 ground conductor saddle and clamp. **High impact phenolic threaded type bushings are not**
32 **acceptable.**
- 33 5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

34 **2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS**

- 35 A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- 36 B. Acceptable Manufacturers of EMT Conduit: Allied, LTV, Steelduct, Wheatland Tube Co, or approved equal.

- 1 C. Fittings and Conduit Bodies:
- 2 1. 2" Diameter or Smaller: Compression type of steel designed for their specific application.
- 3 2. Larger than 2": Compression type of steel designed for their specific application.
- 4 3. Acceptable Manufacturers of EMT Conduit Fittings: Appleton Electric, O-Z/Gedney Co., Electroline,
5 Raco, Bridgeport, Midwest, Regal, Thomas & Betts, or approved equal.

6 **2.4 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS**

- 7 A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an
8 individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG
9 THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- 10 B. Acceptable Manufacturers: American Flex, Alflex, Electri-Flex Co, or approved equal.
- 11 C. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a
12 continuous length of spirally wound, interlocked zinc coated strip steel. Provide a separate equipment
13 grounding conductor when used for equipment where flexibility is required.
- 14 D. Fittings and Conduit Bodies:
- 15 1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-
16 in type, die-cast zinc.
- 17 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer
18 to protect conductors from sharp edges.
- 19 3. Acceptable Manufacturers: O-Z/Gedney Co., Thomas & Betts, Appleton Electric, Electroline,
20 Bridgeport, Midwest, Regal, or approved equal.

21 **2.5 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS**

- 22 A. Acceptable Manufacturers: Anaconda Type UA, Electri-Flex Type LA, Alflex, Carlon (Lamson & Sessions), or
23 approved equal.
- 24 B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a
25 continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.
- 26 C. Fittings and Conduit Bodies:
- 27 1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
- 28 2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer
29 to protect conductors from sharp edges.
- 30 3. Acceptable Manufacturers: Appleton Electric, O-Z/Gedney Co., Electroline, Bridgeport, Thomas &
31 Betts, Midwest, Regal, Carlon (Lamson & Sessions), or approved equal.

32 **2.6 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS**

- 33 A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- 34 B. Acceptable Manufacturers: Carlon (Lamson & Sessions) Type 40, Cantex, J.M. Mfg., or approved equal.
- 35 C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90°C.

1 D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with
2 the conduit by the conduit manufacturer.

3 E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

4 **2.7 HIGH DENSITY POLYETHYLENE (HDPE)**

5 A. Minimum Size: 2 inch, unless noted otherwise.

6 B. Acceptable Manufacturers: Carlon, Chevron Phillips Chemical Company, or approved equal.

7 C. Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight,
8 high-density polyethylene resin. The material shall be listed by PPI (Plastic Pipe Institute) and shall meet the
9 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

10 D. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from
11 resin of the same raw material, including both the base resin and coextruded resin. The pipe shall be
12 homogeneous throughout and free of visible cracks, holes, voids, foreign inclusions, or other defects that may
13 affect the wall integrity.

14 E. Fitting and Conduit Bodies:

15 1. Directional Bore and Plow Type Installation: Electrofusion or Universal Aluminum threaded
16 couplings. Tensile strength of coupled pipe must be greater than 2,000 lbs.

17 2. For all other type of installation: Coupler must provide a water tight connection. The tensile
18 strength of coupled pipe must be greater than 1,000 lbs.

19 3. E-loc type couplings are not acceptable in any situations.

20 4. Acceptable Manufacturers: ARCON, Carlon, or approved equal.

21 **2.8 OUTLET BOXES**

22 A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, minimum of 14 gauge, with 1/2-inch male
23 fixture studs where required.

24 B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.

25 C. Cast Boxes: NEMA FB1, Type FD, Aluminum or cast feralloy, deep type, gasketed cover, threaded hubs.

26 D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or
27 construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a
28 finished trim plate.

29 E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square
30 by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall
31 consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang.
32 Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed
33 concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of
34 sufficient depth to extend out to face of block or masonry boxes.

- 1 F. Outlet boxes for telephone substations in walls and columns shall be 4 inches square and 2-1/8 inches deep
2 with single gang raised cover to fit flush with finished wall line equipped with flush telephone plate.
- 3 G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished
4 wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.
- 5 H. Provide three gang outlet boxes for locations with audio-visual connections. The boxes shall be 4 inches deep
6 and 4.21 inches high.
- 7 **2.9 [ECONN]: ELECTRICAL CONNECTION**
- 8 A. Electrical connection to equipment and motors, sized per NEC. Coordinate requirements with contractor
9 furnishing equipment or motor. Refer to specifications and general installation notes for terminations to
10 motors.
- 11 **2.10 [JB]: PULL AND JUNCTION BOXES**
- 12 A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- 13 B. Sheet metal boxes larger than 12 inches in any dimension that contain terminations or components:
14 Continuous hinged enclosure with 1/4 turn latch and white back panel for mounting terminal blocks and
15 electrical components.
- 16 C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged,
17 surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange,
18 neoprene gasket, and stainless steel cover screws.
- 19 D. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for
20 flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and
21 stainless steel cover screws.
- 22 E. Flanged type boxes shall be used where installed flush in wall.
- 23 **2.11 ROUGH-IN**
- 24 A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,
- 25 B. Conduit stubbed to above the lay-in ceiling.
- 26 C. **[RI-TECH]: Technology Rough-in:**
- 27 1. Rough-in shall have one (1) 1" conduit.
- 28 D. **[RI-TECH-W]: Technology Rough-in - Wall Phone:**
- 29 1. Mount on wall +54" or as noted in plans. Rough-in shall have one (1) 1" conduit.
- 30 E. **[RI-AV]: Audio Visual Outlet Box Rough-in:**
- 31 1. Rough-in shall have a minimum of (2) 1 1/4" conduits. Refer to technology drawings for additional
32 rough-in requirements.
- 33 **2.12 HANDHOLES**
- 34 A. **[HH-1]: Handhole, composite polymer concrete body and cover. Stainless steel hardware. Bolted non-skid
35 cover rated for 15,000 pounds. Design load occasional non-deliberate vehicular traffic. Stack units to achieve
36 depth shown on plans. Units in landscaped areas shall be green in color. 17"W, 30"L, 18"D or dimensions as
37 shown on plans.**

- 1 1. Approved Manufacturers:
- 2 a. Hubbell/Quazite PG#####BB18, PG#####HA00
- 3 b. Carson Industries H Series
- 4 c. Armorcast
- 5 d. Highline Products
- 6 e. Synertech
- 7 B. **[HH-2]:** Handhole, cast iron, hot dipped galvanized with checkered cover sidewalk weatherproof box, flat
- 8 neoprene cover gasket. Stainless steel screw hardware. Mounted flush in concrete. 12"W, 18"L, 12"D or
- 9 dimensions as shown on plans.
- 10 1. Approved Manufacturers:
- 11 a. Appleton Electric WYT Series, WYT 181212
- 12 b. OZ Gedney YT Series
- 13 c. Crouse Hinds WJBF Series

14 **2.13 ACCESSORIES**

- 15 A. Fire Rated Moldable Pads: UL #9700, moldable sheet putty at required thickness on all five sides of back
- 16 boxes. Kinetics Noise Control – IsoBacker Pad, SpecSeal – SSP Putty and Pads, 3M #MPP-4S or equal.
- 17 B. Sound Barrier Insulation Pads: Mastic, non-hardening, sheet material, minimum 1/8" thickness applied to all
- 18 five sides of back boxes. Kinetics Noise Control – SealTight Backer Pad, L.H. DOTTIE Co., #68 or equal.

19 **PART 3 - EXECUTION**

20 **3.1 CONDUIT SIZING**

- 21 A. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents,
- 22 conduit size shall be according to NEC. Conduit and conductor sizing shall be coordinated to limit conductor
- 23 fill to less than 40%, maintain conductor ampere capacity as required by the NEC (to include enlarged
- 24 conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and
- 25 pulling tension due to long conduit/conductor lengths.
- 26 B. Minimum Conduit Size (Unless Noted Otherwise):
- 27 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual
- 28 light switches, individual receptacles and individual fixture whips from junction box.)
- 29 2. Below Grade 5' or less from Building Foundation: 1 inch.
- 30 3. Below Grade More than 5' from Building Foundation: 1 inch.
- 31 4. Telecommunication Conduit: 1 inch.
- 32 5. Controls Conduit: 3/4 inch.
- 33 C. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the
- 34 drawings.

35 **3.2 CONDUIT ARRANGEMENT**

- 36 A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or
- 37 as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed
- 38 structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or
- 39 exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain
- 40 headroom in exposed vicinities of pedestrian or vehicular traffic.

- 1 B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of
2 Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days
3 prior to start of conduit rough-in. Routing shall be shown on coordination drawings.
- 4 C. Conduit shall not share the same cell as structural reinforcement in masonry walls.
- 5 D. Conduit runs shall be routed as shown on large scale drawings. Conduit routing on drawings scaled 1/4"=1'-
6 0" or less shall be considered diagrammatic, unless noted otherwise. The correct routing, when shown
7 diagrammatically shall be chosen by the Contractor based on information in the contract documents, in
8 accordance with manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation",
9 in accordance with recognized industry standards, and coordinated with other contractors.
- 10 E. Contractor shall adapt his work to the job conditions and make such changes as required and permitted by
11 the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference
12 with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
- 13 F. Contractor shall cooperate with all Contractors on the project. He shall obtain details of other Contractor's
14 work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid
15 for in full by him. The other trades involved as directed by the Architect/Engineer shall perform the repair of
16 work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This
17 Contractor.
- 18 **3.3 CONDUIT SUPPORT**
- 19 A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on
20 the suspended ceiling construction, nor utilize ceiling support system for conduit support.
- 21 B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members,
22 unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural
23 members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- 24 C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit
25 straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- 26 D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- 27 E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of
28 malleable-iron hangers for 1" and smaller raceways serving lighting and receptacle branch circuits above
29 accessible ceilings and for securing raceways to slotted channel and angle supports.
- 30 F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel
31 channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or
32 clamps. Provide space in each rack or trapeze for 25% additional conduits.
- 33 G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof
34 decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and
35 mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off
36 steel framing will need to be added.
- 37 H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by
38 raceway supports, with no weight load on raceway terminals.
- 39 I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated
40 by building construction, but in no event shall support spans exceed the NEC requirements. Conduit shall be
41 securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
- 42 J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or
43 fitting and at intervals not to exceed 4.5 feet.

- 1 K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit.
2 The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the NEC
3 requirements.
- 4 L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts
5 securely fastened to forms to prevent conduit misplacement.
- 6 M. Finish:
- 7 1. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts,
8 and above suspended ceiling spaces are not considered exposed.
- 9 2. Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within
10 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the
11 drawings. Smooth ends and install elastomeric insulation with two coats of latex paint if exposed
12 steel is within 6'-6" of finish floor and presents potential injury to personnel.
- 13 **3.4 CONDUIT INSTALLATION**
- 14 A. Conduit Connections:
- 15 1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all
16 conduits cut shall be reamed or otherwise finished to remove all rough edges.
- 17 2. Metallic conduit connections in slab on grade installation shall be sealed and one coat of rust
18 inhibitor primer applied after the connection is made.
- 19 3. Where conduits with tapered threads cannot be coupled with standard couplings, then approved
20 split or Erickson couplings shall be used. Running threads will not be permitted.
- 21 4. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
- 22 B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every
23 conduit run.
- 24 C. Conduit Bends:
- 25 1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger.
26 All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
- 27 2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved
28 bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
- 29 3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360°),
30 including those bends located immediately at the outlet or body.
- 31 4. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points
32 and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits
33 exceeding 100 feet in length.
- 34 a. A third bend is acceptable if:
- 35 1) The total run is not longer than (33) feet.
36 2) The conduit size is increased to the next trade size.
- 37 5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull
38 box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the
39 largest conduit. Slip sleeves or gutters can be used in place of a pull box.

- 1 6. Telecommunications conduit bend radius shall be six (6) times the diameter for conduits under 2"
2 and ten (10) times the diameter for conduits over 2".
- 3 7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two
4 90° equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
- 5 8. Use conduit bodies to make sharp changes in direction (i.e. around beams).
- 6 D. Conduit Placement:
- 7 1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be
8 electrically continuous from source of current to all outlets, unless a properly sized grounding
9 conductor is routed within the conduit. All metallic conduits shall be bonded per the NEC.
- 10 2. Route exposed conduit and conduit above suspended ceilings (accessible or not)
11 parallel/perpendicular to the building structural lines, and as close to building structure as possible.
12 Wherever possible, route horizontal conduit runs above water and steam piping.
- 13 3. Route conduit through roof openings provided for piping and ductwork where possible. If not
14 provided or routing through provided openings is not possible, route through roof jack with pitch
15 pocket. Coordinate roof penetrations with other trades.
- 16 4. Conduits, raceway, and boxes shall not be installed in concealed locations in metal deck roofing or
17 less than 1.5" below bottom of roof decking.
- 18 5. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting
19 at conduit low point.
- 20 6. All conduits through walls shall be grouted or sealed into openings. Where conduit penetrates
21 firewalls and floors, seal with a UL listed sealant. Seal penetrations with intumescent caulk, putty,
22 or sheet installed per manufacturer's recommendations. All materials used to seal penetrations of
23 firewalls and floors shall be tested and certified as a system per ASTM E814 Standard for fire tests
24 or through-penetration fire stops as manufactured by 3M or approved equal.
- 25 7. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR
26 WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL
27 REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
- 28 8. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the
29 temperature differential can potentially be greater than 20°F, to prevent moisture penetration. Seal
30 shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with
31 sealing compound, equal to O-Z/Gedney type EYD.
- 32 9. Horizontal conduit routing through slabs above grade:
- 33 a. No conduits are allowed to be routed horizontally through slabs above grade.
- 34 10. Do not route conduits across each other in slabs on grade.
- 35 11. Rigid polyvinyl chloride conduit (PVC) shall be installed when material surface temperatures and
36 ambient temperature are greater than 40°F.
- 37 12. Where rigid polyvinyl chloride conduit (PVC) is used below grade, in a slab, below a slab, etc., a
38 transition to rigid galvanized steel or PVC-coated steel conduit shall be installed before conduit exits
39 earth. The metallic conduit shall extend a minimum of 6" into the surface concealing the
40 non-metallic conduit.

- 1 13. Contractor shall provide suitable mechanical protection around all conduits stubbed out from
2 floors, walls or ceilings during construction to prevent bending or damaging of stubs due to
3 carelessness with construction equipment.
- 4 14. Contractor shall provide a polypropylene pull cord with 2000 lbs. tensile strength in each empty
5 conduit (indoor and outdoor), except in sleeves and nipples.
- 6 15. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3"
7 above finished floor (AFF).
- 8 16. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling
9 shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
- 10 17. Telecommunications conduits that are below grade and enter into a building shall terminate a
11 minimum of 4" above finished floor (AFF) and as close to the wall as possible.

12 **3.5 CONDUIT TERMINATIONS**

- 13 A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a grounding
14 type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas
15 & Betts, Burndy, Regal, or approved equal.
- 16 B. Conduits with termination fittings shall be threaded for one (1) lock nut on the outside and one (1) lock nut
17 and bushing on the inside of each box.
- 18 C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and
19 provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- 20 D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed
21 against the shoulder portion of the threaded openings.
- 22 E. Conduit terminations to all motors shall be made with flexible metallic conduit (FMC), unless noted otherwise.
23 Final connections to roof exhaust fans, or other exterior motors and motors in damp or wet locations shall be
24 made with liquidtight flexible metallic conduit (LFMC). Motors in hazardous areas, as defined in the NEC, shall
25 be connected using flexible conduit rated for the environment. Flexible conduit shall not exceed 6' in length.
26 Route equipment ground conductors from circuit ground to motor ground terminal through flexible conduit.
- 27 F. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the
28 manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's
29 recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement
30 to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let
31 the joint cure for 1-hour minimum or as per the manufacturer's recommendations.
- 32 G. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any
33 foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign
34 matter prior to any wires or pull cords being installed.

35 **3.6 UNDERGROUND CONDUIT INSTALLATION**

- 36 A. Conduit Connections:
- 37 1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.
- 38 B. Conduit Bends (Lateral):
- 39 1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends
40 are indicated and noted on the drawings, or as required by the manufacturer of the equipment or
41 system being served.

- 1 2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and
2 ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures
3 may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to
4 determine bend radius.
- 5 C. Conduit Elbows (vertical):
- 6 1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (>600V) and 18
7 inches for secondary conduits (<600V). Increase radius, as required, based on pulling tension
8 calculation requirements.
- 9 D. Conduit Placement:
- 10 1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct
11 runs shall be installed deeper than the minimum wherever required to avoid any conflicts with
12 existing or new piping, tunnels, etc.
- 13 2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band
14 conduit together with suitable banding devices. Securely anchor conduit to prevent movement
15 during concrete placement or backfilling.
- 16 3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum
17 f'c = 2500 and immediately placed in the trench around the conduits. No concrete that has been
18 allowed to partially set shall be used.
- 19 4. Before the Contractor pulls any cables into the conduit he shall have a mandrel 1/4" smaller than
20 the conduit inside diameter pulled through each conduit and if any concrete or obstructions are
21 found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared
22 of all obstructions.
- 23 5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable
24 iron end bell fittings.
- 25 6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as
26 described above.
- 27 7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise
28 noted on the drawings or elsewhere in these specifications.
- 29 8. All non-metallic conduit installed underground outside of a slab shall be rigid.
- 30 E. Horizontal Directional Drilling:
- 31 1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated
32 with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for
33 any surface geo-magnetic variations or anomalies.
- 34 2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by
35 hand digging or vacuum excavation. Restore inspection holes to original condition after verification.
- 36 F. Raceway Seal:
- 37 1. Where a raceway enters a building or structure, it shall be sealed with a sealing bushing or duct seal
38 to prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway
39 system. Spare or unused raceway shall also be sealed.

1 2. All telecommunications conduits and innerducts, including those containing cables, shall be plugged
2 at the building and vault with "JackMoon" or equivalent duct seal, capable of withstanding a 10-
3 foot head of water (5 PSI).

4 **3.7 CONDUIT INSTALLATION SCHEDULE**

5 A. In the event the location of conduit installation represents conflicting installation requirements as specified
6 in the following schedule, a clarification shall be obtained from the Architect/Engineer. If This Contractor is
7 unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these
8 specifications and the NEC shall be required.

9 B. The following schedule shall be adhered to unless they constitute a violation of applicable codes or are noted
10 otherwise on the drawings. The installation of RMC conduit will be permitted in place of all conduit specified
11 in this schedule.

12 1. Exposed:

13 a. Switchboards, panel feeders, etc.: IMC.

14 b. Branch Circuits (lighting, receptacles, controls, etc.): EMT.

15 c. Mechanical Equipment Feeders (pumps, AHUs, chillers, etc.): EMT.

16 d. Floor Mounted Pump Feeders: EMT with no more than 6' of PVC coated flexible metal
17 conduit to pump.

18 e. Controls: EMT painted blue or dyed blue.

19 2. Finished Spaces/Concealed: EMT.

20 3. Wet or Damp Locations: RMC conduit, boxes and fittings, installed and equipped to prevent water
21 from entering the conduit system.

22 4. Corrosive Locations: PVC Coated Rigid Metal conduit, boxes and fittings installed and equipped to
23 prevent water from entering the conduit system.

24 5. In or Under Slabs on Grade:

25 a. Within 5' from the perimeter of the building: RMC

26 b. Within 5' from the perimeter of the building when passing through the perimeter of the
27 building foundation: RMC conduit with a minimum of 3" thickness between the surface
28 of the concrete and the nearest conduit. Concrete to be doweled into the foundation.

29 6. Site Conduits:

30 a. Within 5' from the Perimeter of a Building Foundation: RMC conduit with a minimum of
31 3" thickness between the surface of the concrete and the nearest conduit. Concrete to be
32 doweled into the foundation.

33 b. 5' or Greater from the Perimeter of a Building Foundation: PVC.

34 7. Interior Locations:

35 a. Exposed: EMT conduit.

36 1) Exposed Controls Conduit: EMT painted blue or dyed blue.

-
- 1 b. Concealed: EMT.
- 2 8. Hazardous Locations as Defined by the NEC: RMC conduit complete with screwed fittings and
3 conduit seals.
- 4 **3.8 BOX INSTALLATION SCHEDULE**
- 5 A. Galvanized steel boxes may be used in:
- 6 1. Concealed interior locations above ceilings and in hollow studded partitions.
7 2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above
8 the highest platform level.
9 3. Direct contact with concrete except slab on grade.
10 4. Recessed in stud wall of kitchens and laundries.
- 11 B. Cast boxes shall be used in:
- 12 1. Exterior locations.
13 2. Hazardous locations.
14 3. Exposed interior locations within 8' of the highest platform level.
15 4. Direct contact with earth.
16 5. Direct contact with concrete in slab on grade.
17 6. Wet locations.
18 7. Kitchens and laundries when exposed on wall surface.
- 19 **3.9 COORDINATION OF BOX LOCATIONS**
- 20 A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment
21 connections, and code compliance.
- 22 B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location
23 of floor boxes and outlets in offices and work areas prior to rough-in.
- 24 C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment,
25 etc. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access
26 doors with the Architect/Engineer and General Contractor.
- 27 D. Locate and install to maintain headroom and to present a neat appearance.
- 28 E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.
- 29 **3.10 OUTLET BOX INSTALLATION**
- 30 A. Do not install boxes back-to-back in walls.
- 31 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of
32 non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation
33 pads on all five sides of the back box in accordance with the manufacturer's instructions.
- 34 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides
35 of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than
36 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to
37 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the
38 fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product.
39 Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product
40 carries the necessary fire rating.

- 1 B. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-
2 rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.
- 3 C. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished
4 masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is
5 being installed to assure that the box is flush. (Provide plaster rings as necessary.)
- 6 D. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
- 7 E. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to
8 achieve neat openings for boxes.
- 9 F. Provide knockout closures for unused openings.
- 10 G. Support boxes independently of conduit.
- 11 H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes.
12 Provide barriers to separate wiring of different voltage systems.
- 13 I. Install boxes in walls without damaging wall insulation.
- 14 J. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and
15 below baseboard radiation.
- 16 K. Position outlets to locate luminaires as shown on reflected ceiling drawings.
- 17 L. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be
18 accessible through luminaire ceiling opening.
- 19 M. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately
20 positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud
21 wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- 22 N. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- 23 O. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate
24 conduit is used.

25 **3.11 PULL AND JUNCTION BOX INSTALLATION**

- 26 A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- 27 B. Support pull and junction boxes independent of conduit.
- 28 C. Do not install boxes back-to-back in walls.
- 29 1. Provide a minimum horizontal separation of 6 inches between boxes installed on opposite sides of
30 non-rated stud walls. When the minimum separation cannot be maintained, install sound insulation
31 pads on all five sides of the back box in accordance with the manufacturer's instructions.
- 32 2. Provide a minimum horizontal separation of 24 inches between boxes installed on opposite sides
33 of fire-rated walls. When the minimum separation cannot be maintained, the box is greater than
34 16 square inches or the total box area (all trades) per 100 square feet is greater than or equal to
35 100 square inches, install fire-rated moldable pads to all five sides of the back box to maintain the
36 fire rating of the wall. Install moldable pads in accordance with UL listing for the specific product.
37 Sound insulation pads are not acceptable for use in fire-rated wall applications unless the product
38 carries the necessary fire rating.

1 D. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-
2 rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.

3 **3.12 EXPOSED BOX INSTALLATION**

4 A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel
5 elements.

6 B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2)
7 Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head
8 machine screws. Cast boxes shall not be drilled.

9 C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the
10 member and fastening the boxes by means of round head machine screws.

11 D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam
12 clamps.

13 E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large
14 and long to properly support. (Quantity depends on size of box.)

15 F. Wood, plastic, or fiber plugs shall not be used for fastenings.

16 G. Explosive devices shall not be used unless specifically allowed.

17 **END OF SECTION**

SECTION 26 05 36
CABLE TRAYS

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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.

1 B. Include cleaning and bolt-tightening procedures.

2 C. Note grounding point on as-built drawings.

3 **1.8 COORDINATION**

4 A. Coordinate layout and installation of cable trays and suspension system with other construction, including
5 structural members, light fixtures, HVAC equipment, fire suppression systems, and partition assemblies.

6 **PART 2 - PRODUCTS**

7 **2.1 GENERAL**

8 A. Provide all cable tray with all fittings and mounting hardware. Install according to NEMA class with 1.5 safety
9 factor.

10 B. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates,
11 blind ends, barrier strips, connectors, and grounding straps.

12 C. Refer to manufacturers installation instructions and specific product data below for additional information.

13 **2.2 CHANNEL-TYPE CABLE TRAYS**

14 A. Channel type cable tray, ventilated, aluminum pre-galvanized steel 12" width, 4" depth.

15 1. Approved Manufacturers: Cooper B-Line Channel CC Series, Cope, Thomas & Betts.

16 **2.3 WELDED WIRE MESH CABLE TRAYS**

17 A. Wire mesh type cable tray, 4" loading depth, 12" width. Provide trapeze support with plastic retainer.

18 1. Approved Manufacturers: B-Line, Mono-Systems, Cope, Cablofil Inc., Hubbell HBT.

19 B. Tray: Continuous, rigid, welded steel wire mesh cable tray with continuous top wire safe edge with T-weld.

20 C. Wire mesh shall be welded at all intersections.

21 D. Material: Carbon steel wire, 0.197" minimum wire diameter, ASTM A510, Grade 1008. Wire shall be welded,
22 formed and surface treated.

23 E. Finish: Finish shall be applied after welding and bending of mesh. Finish shall be electro-plated zinc
24 galvanizing: ASTM B633, Type I, SC-1.

25 F. Provide grounding clip for continuous grounding of tray.

26 G. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, and miscellaneous
27 hardware as required for a complete and functioning installation to manufacturer's recommendations.

28 H. Load Span Criteria: Install and support cable management system in accordance with span load criteria of
29 L/240.

30 **2.4 WARNING SIGNS**

31 A. Provide manufacturer's standard, permanent, legible warning label indicating the following:

32 WARNING! DO NOT USE AS A WALKWAY, LADDER, OR SUPPORT FOR PERSONNEL. TO BE USED ONLY AS
33 MECHANICAL SUPPORT FOR CABLES AND TUBING!

1 B. Label shall also indicate cable tray NEMA load class. Label shall be a maximum of 10' on center.

2 **PART 3 - EXECUTION**

3 **3.1 INSTALLATION**

4 A. Cable trays provided for Division 27 structured cabling systems only.

5 B. Installation: In conformance with NEMA VE 2 requirements and in accordance with manufacturer's
6 instructions.

7 C. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing
8 between supports of 8 ft. maximum.

9 D. Use expansion connectors where indicated in NEMA VE 1.

10 E. Cut standard straight sections to length in field.

11 F. Tray shall be electrically continuous from source to termination and shall not change elevation, direction or
12 otherwise expose cables to travel without support.

13 G. Tray shall be field cut using the manufacturer's approved cutting device and methods. Cutting device shall be
14 an offset blade bolt cutter. The use of standard bolt cutters is strictly prohibited.

15 H. Bends in tray shall be accomplished by utilizing manufacturer's cutting guides.

16 I. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

17 J. Provide bonding continuity between cable tray sections, fittings and conduit terminations in accordance with
18 manufacturer's instructions. Tighten electrical connectors and terminals according to manufacturer's
19 published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in
20 UL 486A and UL 486B.

21 K. Remove burrs and sharp edges from cable trays.

22 L. Seal penetrations through fire and smoke barriers.

23 M. Install capped sleeves for future cables through firestop sealed cable tray penetrations of fire and smoke
24 barriers as shown on drawings.

25 N. Install cable trays with sufficient space to permit access for installing cables. Install tray bottom within 18" of
26 access ceiling paneling for ease of access. Adjust mounting height only momentarily for field coordination
27 with other trades and systems as required.

28 O. Provide separation of cables of different systems, such as power, telecommunications, fire alarm system,
29 security systems and audio or visual systems. Install barriers between power and low voltage cables.

30 **END OF SECTION**

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**SECTION 26 05 53
ELECTRICAL IDENTIFICATION**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Adhesive labels, markings, nameplates, and signs
- B. Wire and cable markers
- C. Raceway, box, and wire identification
- D. Equipment short circuit current rating (SCCR) labeling
- E. Electrical equipment labeling

1.2 REFERENCES

- A. ANSI C2 – National Electrical Safety Code
- B. NFPA 70 – National Electrical Code (NEC)
- C. ANSI A13.1 – Standard for Pipe Identification
- D. ANSI Z535.4 – Standard for Product Safety Signs and Labels

PART 2 - PRODUCTS

2.1 ADHESIVE MARKINGS AND FIELD LABELS

- A. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch (25mm) to 2 inches (50mm) 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 (5mm) minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F (10°C to 176°C). 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-inch (25mm) width, 0.014 (5mm) 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" (50mm) by 2" (50mm) by .05-inch (2mm) metal tags with stamped legend, punched for fastener.
- H. Indoor/Outdoor Number and Letters: Outdoor grade vinyl label with acrylic adhesive designed for permanent application in severe indoor and outdoor environments.

1 **2.2 NAMEPLATES AND SIGNS**

- 2 A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate,
3 1/16-inch (2mm) minimum thick for signs up to 20 square inches (13 square cm), or 8 inches (200mm) in
4 length; 1/8 inch (3mm) thick for larger sizes. Labels shall be punched for mechanical fasteners.
- 5 B. Baked–Enamel Signs for interior Use: Preprinted aluminum signs, punched, or drilled for fasteners, with
6 colors, legend, and size required for application. Mounting ¼" grommets in corners.
- 7 C. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate
8 signs with 0.0396 inch (10mm) galvanized-steel backing: and with colors, legend, and size required for
9 application. Mounting 1/4" grommets in corners.
- 10 D. Safety Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145.
- 11 E. Fasteners for Plastic-Laminated Signs; Self-tapping stainless steel screws or number 10/32 stainless steel
12 machine screws with nuts and flat and lock washers.

13 **2.3 PRODUCT COLORS**

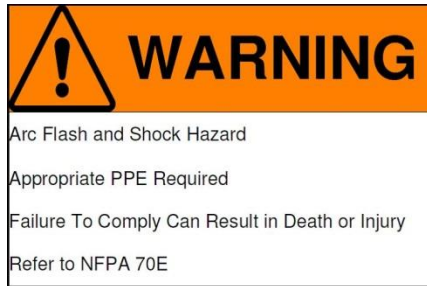
- 14 A. Adhesive Markings and Field Labels:
- 15 1. All Labels: Black letters on white face
- 16 B. Nameplates and Signs:
- 17 1. NORMAL POWER: Black letters on white face
18 2. EMERGENCY: White letters on red face
19 3. GROUNDING: White letters on green face.
20 4. CAUTION or UPS: Black letters on yellow face
- 21 C. Raceways and Conduit:
- 22 1. Provide color coded conduit as indicated below. Conduit shall be colored by the manufacturer:
- 23 a. Normal Power and General Distribution: Silver
24 b. Emergency Power Distribution System:
- 25 1) All Emergency: Orange
- 26 c. Fire Alarm System: Red
27 d. Temperature Controls: Blue
28 e. Ground: Green
29 f. Low Voltage and Telephone: Purple
30 g. Clock, Sound, Security System, and Intercom: Black
- 31 D. Box Covers:
- 32 1. Box cover colors shall match conduit colors listed above.
- 33 E. Conductor Color Identification: Refer to Part 3 for additional information.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical
4 identification work with corresponding designations specified or indicated. Install numbers, lettering, and
5 colors as required by code.
- 6 B. Electrical System Color Chart: This Contractor shall furnish and install framed 8" x 12" charts of the color-
7 coded identification scheme used for the electrical system in all electrical rooms and next to the main fire
8 alarm panel.
- 9 C. Install identification devices in accordance with manufacturer's written instruction and requirements of NEC.
- 10 D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification
11 after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification
12 installation.
- 13 E. Circuit Identification: Tag or label conductors as follows:
- 14 1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are
15 terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
- 16 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and
17 communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes,
18 troughs, and control cabinets. Use consistent letter/number conductor designations throughout on
19 wire/cable marking tape.
- 20 3. Match identification markings with designations used in panelboards shop drawings, Contract
21 Documents, and similar previously established identification schemes for the facility's electrical
22 installations.
- 23 F. Apply warning, caution and instruction signs as follows:
- 24 1. Install warning, caution or instruction signs where required by NEC, where indicated, or where
25 reasonably required to assure safe operation and maintenance of electrical systems and of the
26 items to which they connect. Install engraved plastic-laminated instruction signs with approved
27 legend where instructions or explanations are needed for system or equipment operation. Install
28 metal-backed butyrate signs for outdoor items.
- 29 2. Emergency Operating Signs: Install, where required by NEC, where indicated, or where reasonably
30 required to assure safe operation and maintenance of electrical systems and of the items to which
31 they connect, engraved laminate signs with white legend on red background with minimum 3/8-
32 inch (10mm) high lettering for emergency instructions on power transfer, load shedding, or other
33 emergency operations.
- 34 G. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights,
35 alarm/signal components, and similar items, except where labeling is specified elsewhere.
- 36 H. Install labels parallel to equipment lines at locations as required and at locations for best convenience of
37 viewing without interference with operation and maintenance of equipment.

- 1 I. Install ARC FLASH WARNING signs on all switchboards, panelboards, industrial control panels, and motor
2 control centers. Sign at a minimum shall contain:



- 3
4 J. Circuits with more than 600V: Identify raceway and cable with "DANGER—HIGH VOLTAGE" in black letters 2
5 (50mm) inches high on orange background at 10'-0 foot (3m) intervals.

- 6 1. Entire floor area directly above conduits running beneath and within 12 inches (305mm) of a
7 basement or ground floor that is in contact with earth or is framed above unexcavated space.
8 2. Wall surfaces directly external to conduits concealed within wall.
9 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in building,
10 or concealed above suspended ceilings.

- 11 K. Underground Electrical Lines: For exterior underground power, control, signal, and communication lines,
12 install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm)
13 inches below grade. A single plastic line marker is permitted when the width of the common trench does not
14 exceed 16 inches (405mm); provide a second plastic line marker to mark each edge of the trench when 16
15 inches (405mm) of width is exceeded. Install line marker for underground wiring, both direct-buried cables
16 and cables in raceway.

17 **3.2 LIGHTING CONTROL AND RECEPTACLE COVER PLATES**

- 18 A. Product:
19 1. Adhesive labels and field markings
20 2. Nameplates and signs
21 B. Identification material to be a clear, 3/8-inch (10mm) Kroy tape or Brother self-laminating vinyl label with
22 black letters. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover
23 plates, centered above the receptacle openings.
24 C. Provide identification on all switch and receptacle cover plates. Identification shall indicate source and circuit
25 number serving the device (e.g. "C1A #24"). Identification for switch cover plates shall be installed on the
26 inside cover.

27 **3.3 BOX LABELING**

- 28 A. Products:
29 1. Adhesive labels and field markings
30 B. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch (10mm) Kroy tape or Brother self-
31 laminating vinyl label, letters/numbers color coded same as conduits. In rooms that are painted out, provide
32 labeling on inside of cover.

- 1 C. All junction, pull, and connection boxes shall be identified as follows:
- 2 1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V,
3 1LA1-3,5,7").
- 4 2. For other wiring, indicate system type and description of wiring ("FIRE ALARM NAC #1").

5 **3.4 CONDUCTOR COLOR CODING**

- 6 A. Products:
- 7 1. All wire and cables shall be color coded by the manufacturer.
- 8 B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where
9 the wires and cables are visible and terminations are made. The same color coding shall be used throughout
10 the entire electrical system, therefore maintaining proper phasing throughout the entire project.
- 11 C. Colored cable ties shall be applied in groups of three ties of specified color to each conductor at each terminal
12 or splice point starting 3 inches (76mm) from the termination and spaced at 3-inches (76mm) centers. Tighten
13 to a snug fit, and cut off excess length.
- 14 D. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of
15 a multi-wire branch circuit, where accessible, shall be identified by phase and system.
- 16 E. Conductors shall be color coded as follows:
- 17 1. 120/240 Volt, 3-Wire:
- 18 a. A-Phase – Black
19 b. B-Phase – Red
20 c. Neutral – White
21 d. Ground Bond – Green
- 22 2. 208Y/120 Volt, 4-Wire:
- 23 a. A-Phase – Black
24 b. B-Phase – Red
25 c. C-Phase – Blue
26 d. Neutral – White
27 e. Ground Bond – Green
- 28 3. 480Y/277 Volt, 4-Wire:
- 29 a. A-Phase – Brown
30 b. B-Phase – Orange
31 c. C-Phase – Yellow
32 d. Neutral – Gray
33 e. Ground Bond – Green

34 **3.5 CONTROL EQUIPMENT IDENTIFICATION**

- 35 A. Products:
- 36 1. Nameplates and signs
- 37 B. Provide identification on the front of all control equipment such as combination starters, starters, VFDs,
38 contactors, motor control centers, etc.

- 1 C. Identification shall be provided for all connections to equipment furnished by this Contractor, other
2 contractors, or the Owner.
- 3 D. Labeling shall include:
- 4 1. Equipment type and contract documents designation of equipment being served.
5 2. Location of equipment being served if it is not located within sight.
6 3. Voltage and phase of circuit(s).
7 4. Panel and circuit number(s) serving the equipment.
8 5. Method of automatic control, if included ("AUTO CONTROL BY FCMS").
9 6. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
10 7. Date of fault current study, refer to one-line diagram

EXHAUST FAN EF-1
("LOCATED ON ROOF")
480V, 3-PHASE
FED FROM "1HA1-1"
AUTO CONTROL BY FCMS
22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

11 **3.6 EQUIPMENT CONNECTION IDENTIFICATION**

- 12 A. Products:
- 13 1. Nameplates and signs
- 14 B. Provide identification for hard wired electrical connections to equipment such as disconnects switches,
15 starters, etc. Plug and cord type connections do not require this specific label.
- 16 C. Identification shall be provided for all connections to equipment furnished by this Contractor, other
17 contractors, or the Owner.
- 18 D. Labeling shall include:
- 19 1. Equipment type and contract documents designation of equipment being served
20 2. Location of equipment being served if it is not located within sight.
21 3. Voltage and rating of the equipment.
22 4. Panel and circuit numbers(s) serving the equipment
23 5. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
24 6. Date of fault current study; refer to one-line diagram

UNIT HEATER UH-1
("LOCATED IN STORAGE ROOM 200")
480V: 3-PHASE
FED FROM "1HA1-1"
22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

25 **3.7 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION**

- 26 A. Products:
- 27 1. Nameplates and signs

- 1 B. Provide identification on the front of all power distribution equipment such as panelboards, switchboards,
2 switchgear, motor control centers, generators, UPS, storage battery disconnects, transfer switches, etc.
3 Labels shall be visible on the exterior of the gear, correspond to the one-line diagram nomenclature, and
4 identify each cubicle of multi-section gear.
- 5 1. Interior Equipment: The identification material shall be engraved plastic-laminated labels.
6 2. Exterior Equipment: The identification material shall be engraved vinyl labels.
7 3. Labeling shall include:
- 8 a. Equipment type and contract documents designation of equipment.
9 b. Voltage of the equipment.
10 c. Name of the upstream equipment and location of the upstream equipment if it is not
11 located within sight.
12 d. Rating and type of the overcurrent protection device serving the equipment if it is not
13 located within sight ("FED BY 400A/3P BREAKER").

DISTRIBUTION PANEL DP-H1
480Y/277V
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELEC ROOM)

- 14 4. Provide the following on a separate label, installed below the label above:
- 15 a. Available fault current; refer to one-line diagram or panel schedules
16 b. Date of fault current study; refer to one-line diagram

22,000 AMPS AVAILABLE FAULT CURRENT
DATE OF STUDY: 1 JAN 2017

- 17 C. Service Equipment Label: A separate nameplate for the service entrance equipment and include:
- 18 1. Nominal system voltage
19 2. Maximum available fault current; refer to one-line diagram for values
20 3. Clearing time of overcurrent protection devices based on available fault current. Refer to
21 calculations and report from Section 26 05 73 for value.
22 4. Date of fault current study; refer to one-line diagram
23 5. Date of label

480Y/277V
39,800 AMPS AVAILABLE FAULT CURRENT
0.07 SECOND CLEARING TIME
DATE OF STUDY: 1 JAN 2017
DATE OF LABEL: 4 JUL 2017

- 24 D. Arc Energy Reduction Label:
- 25 1. Provide a separate engraved plastic laminate label centered at the top of each vertical section of
26 the electrical gear indicating the following when applicable.
- 27 a. Label: "This equipment is designed with a system listed below".

- 1 b. Applicable Systems:
- 2 1) Zone-selective interlocking system for selective coordination and arc energy
- 3 reduction
- 4 2) Differential relaying system for selective coordination and arc energy reduction
- 5 3) Arc energy reducing maintenance switch
- 6 4) Energy reducing active arc flash mitigation system
- 7 E. Nominal System Voltage Label:
- 8 1. Where more than one nominal voltage system exists in a building or facility, the identification of
- 9 color coding used in the panelboard or equipment shall be permanently posted on the interior of
- 10 the door or cover.
- 11 F. Distribution panelboards and switchboards shall have each overcurrent protection device identified with
- 12 name and location of the load being served ("AHU-1 LOCATED IN PENTHOUSE 1").
- 13 G. Branch panelboards shall be provided with typed panel schedules upon completion of the project. Existing
- 14 panelboards shall have their existing panel schedules typed, with all circuit changes, additions or deletions
- 15 also typed on the panel schedules. A copy of all panel schedules for the project shall be turned over as part
- 16 of the O&M Manuals. Refer to Section 26 05 00 for other requirements.

17 **3.8 INDUSTRIAL CONTROL PANEL IDENTIFICATION**

- 18 A. Products:
- 19 1. Nameplates and signs
- 20 B. Provide identification on the front of all industrial control panels and similar equipment. Labels shall be visible
- 21 on the exterior of the gear and correspond to the one-line and/or schematic diagram nomenclature.
- 22 1. Interior equipment: The identification material shall be engraved plastic-laminated labels.
- 23 2. Labeling shall include:
- 24 a. Equipment type and contract documents designation of equipment.
- 25 b. Manufacturer / Assembler of industrial control panel
- 26 c. Voltage, phase, frequency, full load current of each supply circuit
- 27 d. Name of the upstream equipment and location of the upstream equipment if it is not
- 28 located within sight.
- 29 e. Rating and type of the overcurrent protection device serving the equipment if it is not
- 30 located within sight ("FED BY 400A/3P BREAKER").

<p>INDUSTRIAL CONTROL PANEL ICP-1 ABC COMPANY</p> <p>480V, 3PHASE, 60HZ, 60A (PANEL E1-1 LOCATED IN ELEC 123) 120V, 1PHASE, 60HZ, 20A (PANEL E2-1 LOCATED IN ELEC 123)</p> <p>22,000 SHORT CIRCUIT RATING</p>

- 31 C. Nominal System Voltage Label:
- 32 1. Where more than one nominal voltage system exists in a building or facility, the identification of
- 33 color coding used shall be permanently posted on the interior of the door or cover of the industrial
- 34 control panel.

1 D. Schematic Diagram: Provide a laminated copy of the industrial control panel schematic wiring diagram. Post
2 the diagram on the inside cover of the control panel.

3 E. Service Equipment Label: Refer to Electrical Distribution Equipment - Service Equipment Label of this
4 specification if applicable for additional requirements.

5 **3.9 TRANSFORMER EQUIPMENT IDENTIFICATION**

6 A. Products:

7 1. Nameplates and signs

8 B. Provide identification on the front of all transformers. The identification nameplate shall be an engraved
9 plastic-laminated label.

10 C. Labeling shall include:

11 1. Equipment type and contract documents designation of equipment

12 2. Name of the upstream equipment.

13 3. Voltage and rating of the equipment.

14 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 ELEC 123)
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15 **END OF SECTION**

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**SECTION 26 05 73
POWER SYSTEM STUDY**

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Low voltage distribution system power study.
6 B. Short-circuit analysis and report.
7 C. Coordination analysis and report.

8 **1.2 RELATED SECTIONS**

- 9 A. Section 26 05 00 - Basic Electrical Requirements
10 B. Section 26 24 16 - Panelboards

11 **1.3 SUBMITTALS**

- 12 A. Analyses shall be performed by an agent authorized by the manufacturer of equipment specified in the
13 related specification sections and shall bear the seal/signature of the licensed Professional Engineer who
14 performed the analysis.
- 15 B. The input for the power system study shall be based on the contract documents, with estimated conductor
16 lengths provided by the Electrical Contractor. IMEG will provide a preliminary Power Tools for Windows
17 project file for information, if requested.
- 18 C. Documentation of the analyses shall be submitted in a bound booklet format and shall accompany the shop
19 drawing submittals for equipment provided under the related work specification sections. These shop
20 drawings will not be reviewed without this documentation.
- 21 D. Power system study project model shall be submitted on electronic media for review and the Owner's
22 operating and maintenance records.

23 **1.4 SCOPE**

- 24 A. Provide a power system study of the electrical system shown on the plans. The study shall include arc-fault
25 analysis, selective coordination analysis.
- 26 B. Contractor is required to provide a fully coordinated system for the essential electrical system and the
27 associated normal side of each transfer switch and all other locations indicated on the one line diagram.
28 Contractor shall provide overcurrent protective devices with the appropriate models, frame sizes, trip units,
29 etc. as required to provide a selectively coordinated system.

30 **PART 2 - PRODUCTS**

- 31 **2.1** Power systems study shall be completed in Power Tools for Windows **(PTW) 8.0** or later version or pre-approved
32 equivalent program.

33 **PART 3 - EXECUTION**

34 **3.1 SHORT-CIRCUIT ANALYSIS**

- 35 A. Provide a complete short-circuit analysis from the utility service to and including the entire building
36 distribution as shown on the drawings.

1 B. Analysis shall include the entire distribution system from the point of connection to the utility power source
2 to the distribution panels and branch circuit panelboards.

3 C. Documentation shall be made in one-line diagram form showing the magnitude and location of each
4 calculated fault. Fault current calculations shall be made at the main bus of each switchboard, distribution
5 panel, and branch circuit panel. A summary of the fault currents available shall also be submitted.

6 **3.2 COORDINATION ANALYSIS**

7 A. Provide a complete coordination analysis, comparing time/current curves of the protective devices to be
8 installed to assure the best possible selectivity between main and downstream devices.

9 B. The analysis shall include primary protective device, secondary main switchboard device(s), switchboard
10 branch feeder devices, distribution panel, panelboard main devices, and branch feeder devices.

11 C. The coordination plots provided shall indicate graphically the coordination proposed for the system on full-
12 size log forms and shall define the types of protective devices selected, together with proposed time dial and
13 pickup settings required. The plots shall include titles, representative one-line diagrams, legend, complete
14 parameters for transformer(s), and complete operating bands for circuit breaker trip devices, fuses, etc.

15 1. The long-time region of the coordination plots shall designate the pickups required for the circuit
16 breakers.

17 2. The short-time region shall indicate the magnetizing in-rush and ASA-withstand-transformer
18 parameter, the circuit breaker, short-time and instantaneous trip devices, fuse-manufacturing
19 tolerance bands, significant symmetrical fault currents, etc.

20 3. Each primary protective device required for the transformer shall be selected so the characteristics
21 or operating band is within the transformer parameters, which shall include a parameter equivalent
22 to 58% of the withstand point to afford protection for secondary line-to-ground faults. The
23 transformer damage curve shall be included for the transformer when the selected protective
24 device is not within the associated parameters.

25 4. Molded case circuit breakers shall be separated from each other and the associated primary
26 protective device by a 16% current margin for coordination and protection in the event of secondary
27 line-to-line faults.

28 5. Include zone selective interlocking, differential relaying, and other selective coordination
29 technology in the study when required by other specification sections.

30 6. The protective device characteristics or operating bands shall be suitably indicated to reflect the
31 actual symmetrical fault currents sensed by the device.

32 7. The drawings and specifications indicate the general requirements for motors, motor-starting
33 equipment, and medium-voltage and low-voltage equipment, but additional specific requirements
34 of equipment furnished shall be determined in accordance with the results of the coordination
35 study.

36 a. The study shall include verification of equipment ratings and settings. The Contractor shall
37 keep the study up-to-date with any project changes which affect the study and submit
38 the revised study for review. A final electronic copy shall be submitted with the record
39 drawings.

40 D. Provide summary table of adjustable overcurrent protective devices settings for the operating and
41 maintenance manual.

SECTION 26 09 33
LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Line and low voltage standalone lighting controls
- B. Emergency transfer devices
- C. Time switches

1.2 RELATED WORK

- A. Section 01 91 00 - Commissioning
- B. Section 23 09 00 - Facility Management Control System (FMCS)
- C. Section 26 51 00 - Lighting
- D. Section 27 41 00 - Audio/Visual System

1.3 QUALITY ASSURANCE

- A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. All components and assemblies are to be factory pre-tested prior to delivery and installation.
- C. Comply with NEC as applicable to electrical wiring work.
- D. Comply with applicable portions of NEMA standards pertaining to types of electrical equipment and enclosures.
- E. Panels and accessory devices are to be UL listed under UL 916 Energy Management Equipment. Panels and accessories used for control of life safety and critical branch circuits shall be listed under UL 924 Emergency Lighting and Power Equipment.
- F. All assemblies are to be in compliance with FCC emissions standards specified in Part 15 Subpart J for Class A applications.

1.4 REFERENCES

- A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference
- B. FS W S 896 Switch, Toggle
- C. International Energy Conservation Code (IECC)
- D. NEMA WD 1 - General Color Requirements for Wiring Devices
- E. NEMA WD 7 - Occupancy Motion Sensors
- F. NFPA 70 - National Electrical Code (NEC)
- G. UL Standard 916 Energy Management Equipment
- H. UL 924 - Emergency Lighting and Power Equipment
- I. UL 1472 – Solid-State Dimming Controls

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 26 05 00.

- 1 B. Submit a comprehensive package including devices, hardware, software, product specification, finishes,
2 dimensions, installation instructions, warranty, system software requirements, and roles and responsibilities
3 of all persons and groups involved in installation, execution, and commissioning.
- 4 C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and
5 controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific
6 manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or
7 approved electronic form.
- 8 D. Submit a list of devices and equipment that will be installed for each sequence of operation.
- 9 E. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring
10 requirements for all components including, but not limited to, dimmers, relays, low voltage switches,
11 occupancy sensors, control stations, dimmer panels, relay panels, and communication interfaces and
12 programming instructions for each sequence of operation. Include network cable specification and end-of-
13 line termination details, if required.
- 14 **1.6 EXTRA STOCK**
- 15 A. Provide extra stock under provisions of Section 26 05 00.
- 16 B. Sensors, Controls, Power Supplies, and Relays: Five (5) percent of quantity installed. Minimum of two (2) of
17 each configuration and type.
- 18 C. Relays and Dimmer Modules: Five (5) percent of quantity installed. Minimum of two (2) of each size and type.
- 19 D. Control Stations: One (1) of each configuration and type, except for LCD touch screens requiring factory setup
20 prior to installation.
- 21 **1.7 PROJECT RECORD DOCUMENTS**
- 22 A. Submit project record documents under provisions of Section 26 05 00.
- 23 B. Accurately record location of all controls and devices. Include description of switching sequences and
24 circuiting arrangements.
- 25 **1.8 OPERATION AND MAINTENANCE DATA**
- 26 A. Submit emergency, operation, and maintenance data under provisions of Section 26 05 00. Data shall also
27 include the following:
- 28 1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and
29 system components. Recommended schedule for inspection and recalibration of sensors.
- 30 2. Complete narrative describing intended operation and sequence for each control scenario and
31 system component, updated to reflect all changes resulting from commissioning of systems.
32 Narrative shall indicate recommended settings for devices where applicable.
- 33 3. Replacement part numbers for all system components.
- 34 B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.
- 35 C. Submit software operating and maintenance manuals, program software backup on compact disc or
36 compatible media with data files, device address list, and a printout of software application and graphic
37 screens, where applicable.

1 **1.9 SYSTEM DESCRIPTION**

2 A. Performance Statement: This specification section and the accompanying lighting design documents describe
3 the minimum material quality, required features, and operational requirements of the lighting control system
4 (LCS). These documents do not convey every wire that must be installed and every equipment connection
5 that must be made. Based on the performance required of the system, as presented in these documents, the
6 Contractor and system manufacturer/vendor are solely responsible for determining all equipment, wiring,
7 and programming required for a complete and operational system.

8 B. The following control types and features are acceptable. Acceptable control locations are shown on the
9 drawings.

10 1. Line Voltage Control: Control equipment consists of traditional line voltage wiring devices and
11 equipment such as switches, dimmers and combination occupancy/vacancy sensor switches, etc.

12 **1.10 COMMISSIONING**

13 A. Commissioning of a system or systems specified in this section is part of the construction process.
14 Documentation and testing of these systems, as well as training of the Owner's operation and maintenance
15 personnel, is required in cooperation with the Owner's Representative and the Commissioning Agent. Project
16 closeout is dependent on successful completion of all commissioning procedures, documentation, and issue
17 closure. Refer to Division 1 for detailed commissioning requirements.

18 B. This project will have selected building systems commissioned. The Contractor is responsible to execute
19 commissioning. The commissioning process, equipment, and systems to be commissioned are defined in
20 Division 1.

21 C. The Contractor shall notify the Commissioning Agent, Architect/Engineer and Owner's Representative ten
22 (10) working days prior to scheduled commissioning date.

23 D. The commissioning process requires meeting attendance. Refer to Division 1 for meeting requirements.

24 **1.11 WARRANTY**

25 A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and
26 workmanship for a period of two (2) years from date of commissioning.

27 B. Occupancy, vacancy, daylight sensors and controls shall have a five (5) year warranty from date of Substantial
28 Completion.

29 **PART 2 - PRODUCTS**

30 **2.1 LIGHTING CONTROLS**

31 A. All items of material having a similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall
32 be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the
33 specifications.

34 B. Color of lighting controls and sensors shall match the receptacle wiring devices specified in the space.

35 C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device
36 required to accomplish the functions described for the space.

1 **2.2 DEVICE COLOR**

2 A. All switch, lighting controls, and coverplate colors shall be the same as wiring devices, unless indicated
3 otherwise.

4 **2.3 COVERPLATES**

5 A. All switches and lighting controls shall be complete with coverplates that match material and color of the
6 wiring device coverplates in the space.

7 B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of
8 devices used.

9 C. Install nameplate identification as indicated in Section 26 05 53.

10 D. Plate-securing screws shall be metal with head color matching the wall plate finish.

11 **2.4 WALL SWITCHES**

12 A. Refer to Electrical Symbols List for device type.

13 B. **[SW-1P]:** Single Pole Switch:

14 1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.

15 2. Approved Manufacturers: Hubbell HBL1221, Leviton 1221-2, Pass & Seymour PS20AC1, Cooper
16 AH1221.

17 C. **[SW-1P-060]:** Spring Wound Local Timer Switch:

18 1. 125-volt, 20-amp rated. 0 to 60-minute off delay.

19 2. Approved Manufacturers: Paragon SWPD60M, Tork A560M, Mark-Time 9008.

20 D. **[SW-1P-ADJ]:** Local Timer Switch:

21 1. User adjustable timeout, 120/277-volt, 800/1200 watt rating. No minimum load requirement.
22 Flashes lights one minute before timeout.

23 2. Approved Manufacturers: Watt Stopper TS-400, Hubbell Automation TD200.

24 E. **[SW-1P-K]:** Key Lock Single Pole Switch:

25 1. Single throw, 120/277-volt, 20-amp maintained contact. Side and back wired. Provide key to Owner.

26 2. Approved Manufacturers: Hubbell HBL1221L, Leviton 1221-2L, Pass & Seymour PS20AC1-L, Cooper
27 AH1221L.

28 F. **[SW-1P-LH]:** Lighted Handle Single Pole Switch:

29 1. 120 volt maintained contact. Toggle handle. Light on when contact open (switch off). Side and back
30 wired.

31 2. Approved Manufacturers: Hubbell HBL1221ILC, Leviton 1221-LHC, Pass & Seymour PS20AC1-CSL,
32 Cooper 2221LTW.

- 1 G. **[SW-1P-M]:** Momentary Contact Single Pole Switch:
- 2 1. 120/277-volt, 20 amp. Three position, two circuit. Center off toggle spring return handle.
- 3 2. Approved Manufacturers: Hubbell HBL1557, Leviton 1257, Pass & Seymour 1251, Cooper 1995.
- 4 H. **[SW-1P-PL]:** Red Pilot Light Single Pole Switch:
- 5 1. 120 volt maintained contact. Toggle handle. Pilot light on when contact closed (switch on). Side and
- 6 back wired.
- 7 2. Approved Manufacturers: Hubbell HBL1221PL, Leviton 1221-PLR, Pass & Seymour PS20AC1-RPL,
- 8 Cooper AH1221PL.
- 9 I. **[SW-1P-WP]:** Weatherproof Single Pole Switch:
- 10 1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
- 11 Provide with weatherproof coverplate.
- 12 2. Approved Manufacturers: Hubbell1221/HBL1795, Leviton 1221-2, Taymac MM180, Pass & Seymour
- 13 PS20AC1/CA1-GL, Cooper 2221.
- 14 J. **[SW-2P]:** Two Pole Switch:
- 15 1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
- 16 2. Approved Manufacturers: Hubbell HBL 1222, Leviton 1222-2, Pass & Seymour PS20AC2, Cooper
- 17 2222.
- 18 K. **[SW-3W]:** Three-way Switch:
- 19 1. 120/277 volt, 20 amp. Toggle handle, side and back wired.
- 20 2. Approved Manufacturers: Hubbell 1223, Leviton 1223-2, Pass & Seymour PS20AC3, Cooper
- 21 AH1223.
- 22 L. **[SW-3W-EM]:** Emergency Three-way Switch:
- 23 1. 120/277 volt, 20 amp. Red toggle handle, side and back wired.
- 24 2. Approved Manufacturers: Hubbell 1223R, Leviton 1223-2R, Pass & Seymour PS20AC3-RED, Cooper
- 25 AH1223RD.
- 26 M. **[SW-3W-K]:** Key Lock Three Way Switch:
- 27 1. Single throw, 120/277-volt, 20-amp maintained contact. Side and back wired. Provide key to Owner.
- 28 2. Approved Manufacturers: Hubbell HBL1223L, Leviton 1223-2L, Pass & Seymour PS20AC3-L, Cooper
- 29 AH1223L.
- 30 N. **[SW-4W]:** Four-way Switch:
- 31 1. 120/277 volt, 20 amp. Toggle handle, side and back wired.
- 32 2. Approved Manufacturers: Hubbell 1224, Leviton 1224-2, Pass & Seymour PS20AC4, Cooper
- 33 AH1224.

- 1 O. **[SW-4W-K]:** Key Lock Four Way Switch:
- 2 1. Single throw, 120/277-volt, 20-amp maintained contact. Side and back wired. Provide key to Owner.
- 3 2. Approved Manufacturers: Hubbell HBL1224L, Leviton 1224-2L, Pass & Seymour PS20AC4-L.
- 4 P. **[SW-A-TPCO]:** Three Position-Center Off Switch:
- 5 1. 120/277-volt, 20-amp, 2 pole maintained contact. Toggle handle, side and back wired.
- 6 2. Approved Manufacturers: Hubbell HBL1386, Leviton 1286, Pass & Seymour 1226, Cooper 2226.
- 7 Q. **[SW-COMB]:** Combination Single Pole Switch and GFCI Receptacle:
- 8 1. Single throw switch, 120-volt, 15-amp maintained contact. Toggle handle, side and back wired.
- 9 NEMA 5-15R GFCI receptacle with test and reset buttons.
- 10 2. Approved Manufacturers: Hubbell GFSP15, Leviton 7229, Pass & Seymour 1595-SWTTR, Cooper
- 11 VGFS15.
- 12 **2.5 WALL DIMMERS**
- 13 A. UL listed with integral air-gap switch for on/off control.
- 14 B. Integral EMI/RFI suppression.
- 15 C. Non-viewable heat sink.
- 16 D. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to
- 17 purchase and installation.
- 18 E. Dimmer to match device color.
- 19 F. **[SW-D-6]:** 600-Watt Single Pole Incandescent Dimmer:
- 20 1. 120-volt, linear slider operator with positive off. Mount in single gang box.
- 21 2. Approved Manufacturers: Lutron N-600, Lightolier MP600, Pass & Seymour CD700.
- 22 G. **[SW-D-10]:** 1000-Watt Single Pole Incandescent Dimmer:
- 23 1. 120-volt, linear slider operator with positive off. Mount in single gang box.
- 24 2. Approved Manufacturers: Lutron N-1000, Lightolier MP1000, Pass & Seymour CD1100.
- 25 H. **[SW-D-15]:** 1500-Watt Single Pole Incandescent Dimmer:
- 26 1. 120-volt, linear slider operator with positive off. Mount in double gang box.
- 27 2. Approved Manufacturers: Lutron N-1500, Lightolier MP1500, Pass & Seymour CD1600.
- 28 I. **[SW-D-20]:** 2000-Watt Single Pole Incandescent Dimmer:
- 29 1. 120-volt, linear slider operator with positive off. Mount in double gang box.
- 30 2. Approved Manufacturers: Lutron N-2000, Lightolier MP2000, Pass & Seymour CD2000.

- 1 J. **[SW-D-LED]:** LED Electronic Driver Dimmer:
- 2 1. Decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire
3 manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply
4 with IEC 60629 Annex E.
- 5 2. Approved Manufacturers: Compatible with provided LED driver.
- 6 K. **[SW-D3-6]:** 600-Watt Three-Way Incandescent Dimmer:
- 7 1. 120-volt, linear slider operator with positive off. Mount in single gang box.
- 8 2. Approved Manufacturers: Lutron N-603P, Lightolier MP600 MPR-3, Pass & Seymour CD1100.
- 9 L. **[SW-D3-10]:** 1000-Watt Three-Way Incandescent Dimmer:
- 10 1. 120-volt, linear slider operator with positive off. Mount in single gang box.
- 11 2. Approved Manufacturers: Lutron N-1003P, Lightolier MP1000 MPR-3, Pass & Seymour CD1103P.
- 12 M. **[SW-D3-15]:** 1500-Watt Three-Way Incandescent Dimmer:
- 13 1. 120-volt, linear slider operator with positive off. Mount in double gang box.
- 14 2. Approved Manufacturers: Lutron N-1503P, Lightolier MP1500 MPR-3, Pass & Seymour CD11603P.
- 15 N. **[SW-D3-20]:** 2000-Watt Three-Way Incandescent Dimmer:
- 16 1. 120-volt, linear slider operator with positive off. Mount in double gang box.
- 17 2. Approved Manufacturers: Lutron N-2003P, Lightolier MP2000 MPR-3, Pass & Seymour CD2000.
- 18 O. **[SW-D3-LED]:** LED Electronic Driver Three-Way Dimmer:
- 19 1. Decora style linear slider operator with positive off. Color to match adjacent devices. Luminaire
20 manufacturer shall list compatible dimmer manufacturers and models. 0-10V dimmers shall comply
21 with IEC 60929 Annex E.
- 22 2. Approved Manufacturers: Compatible with provided LED driver.
- 23 P. **[SW-OD]:** Wall 0-10V Dimmer / Occupancy sensor:
- 24 1. Wall switch with auto on/off. 120VAC load rating of 0-800 W for electronic ballast, LED. 277VAC
25 load rating of 0-1,800 W for electronic ballast, LED. adjustable OFF delay. 0-10V dimming with up
26 to 30ma sink. Automatic ON/OFF or occupancy on to predetermined dimming level go to last
27 dimming setting upon occupancy.
- 28 2. Approved Manufacturers: Sensor Switch WSX D Series or equal
- 29 Q. **[SW-VD]:** Wall 0-10V Dimmer / Vacancy sensor:
- 30 1. Wall switch with manual on/auto off. 120VAC load rating of 0-800 W for electronic ballast, LED.
31 277VAC load rating of 0-1,800 W for electronic ballast, LED. adjustable OFF delay. 0-10V dimming
32 with up to 30ma sink. manual ON/automatic OFF.
- 33 2. Approved Manufacturers: Sensor Switch WSX D Series or equal

- 1 **2.6 LOCAL DAYLIGHTING CONTROLS**
- 2 A. Standalone Interior Photo Sensors:
- 3 1. **[SW-LS]:** Daylight Level Sensor - On/Off Control - One Zone:
- 4 a. On/Off control. Range of 10-200 FC. Adjustable deadband prevents cycling. Adjustable
5 time delay.
- 6 b. Approved Manufacturers: Watt Stopper LS-102, Sensor Switch CM-PC, Hubbell
7 Automation DLCPC Series, Greengate PPS-4.
- 8 2. **[SW-LS-3Z]:** Daylight Level Sensor and Controller - On/Off Control - Three Zones:
- 9 a. On/off control of up to three 10-amp zones. Range of 10 to 200 FC. Adjustable deadband
10 prevents cycling. Adjustable time delay.
- 11 b. Approved Manufacturers: Watt Stopper LCO-203/LS-290C, Hubbell Automation
12 LUXSTATOCM/LUXSTATLS, LC&D Micro GR/2404 iDH/Pcell, Sensor Switch N-CMPC.
- 13 3. **[SW-LS-D]:** Daylight Level Sensor and Controller - 0-10V Dimming - One Zone:
- 14 a. Dimming control of one 0-10V zone. Range of 10 to 200 FC. Adjustable deadband prevents
15 cycling. Adjustable time delay. Coordinated with dimming ballast prior to submittal.
- 16 b. Approved Manufacturers: Watt Stopper LS-301, Hubble Automation DLC7, Sensor Switch
17 N-CMADC.
- 18 4. **[SW-LS-D-3Z]:** Daylight Level Sensor and Controller - Dimming - Three Zones:
- 19 a. Dimming control of up to three zones of 0-10V. Range of 10 to 200 FC. Adjustable
20 deadband prevents cycling. Adjustable time delay. Coordinate with dimming ballasts prior
21 to submittal.
- 22 b. Approved Manufacturers: Watt Stopper LCD-203/LS-290C, Hubbell Automation
23 LUXSTATDCM/LUXSTATLS, LC&D Micro GR/2404 IDIM/Pcell, Sensor Switch N-CMADC.
- 24 5. Sensor shall detect changes in ambient light level and provide triggering of lighting groups in area
25 based on sequence of operation.
- 26 6. Sensor shall be configurable via DIP switches at device or via handheld wireless remote
27 programming unit. Settings shall include:
- 28 a. Ambient sensitivity range between 1 and 1,000 foot-candles.
29 b. Time delay of 5 to 300 seconds.
30 c. Trigger setpoints with deadband adjustment.
- 31 7. Sensor shall provide on/off setpoints in quantity as specified on drawings and as shown in the
32 sequence of operation.
- 33 8. Sensor shall be ceiling- or wall-mounted for range and viewing angle meeting application
34 requirements as outlined in the sequence of operation.
- 35 9. Output signal from sensor shall be linear with light level.

- 1 B. **[SW-LS-PC]: Standalone Exterior Photo Sensors:**
- 2 1. Sensor shall be within a weatherproof enclosure, with design operation in temperatures of -30°F to
3 +130°F. Sensor shall have threaded stem for box mounting, with knuckle to permit aiming of
4 receptor after installation. Sensor shall be mounted facing north.
- 5 2. Sensor shall contain an integral switching contactor rated for 277-volt operation, with loads of up
6 to 1,800 VA. Contacts shall be configured for zero-crossing closure to provide 100,000 cycle
7 minimum operation.
- 8 3. Sensor shall detect changes in daylight levels to provide triggering of exterior lighting equipment
9 based on the sequence of operation.
- 10 4. Sensor shall be field configurable at the device or via handheld wireless remote controller.
11 Configurable settings shall include:
- 12 a. Ambient sensitivity range of 5 to 1,500 foot-candles.
13 b. Adjustable setpoint.
14 c. Deadband adjustment by percentage of setpoint.
15 d. Time delay of up to five minutes.
- 16 5. Sensor shall be equipped with a lens cover that can be applied for system testing during daylight
17 conditions.
- 18 6. Approved Manufacturers: Paragon, Tork, Intermatic.
- 19 **2.7 INDOOR OCCUPANCY AND VACANCY SENSORS**
- 20 A. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.
- 21 1. All occupancy sensors shall be line voltage type, unless part of the lighting control system.
- 22 2. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when
23 unoccupied, with a time delay for turning lights off, adjustable over a minimum range of 1 to 30
24 minutes. Vacancy sensors require a manual switch operation to turn lights on and off, with a time
25 delay for turning lights off when unoccupied.
- 26 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
- 27 4. Relay Unit: Dry contacts rated for 20 A driver load at 120 and 277 VAC and for 1 hp at 120 VAC.
- 28 5. Mounting:
- 29 a. Sensor: Suitable for mounting in any position on a standard outlet box.
- 30 b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
31 Mount relay above accessible ceiling near entry door to room or area.
- 32 c. Time Delay and Sensitivity Adjustments: Recessed and concealed.
- 33 6. Indicator: LED to show when motion is being detected during testing and normal operation of the
34 sensor.
- 35 7. Bypass Switch: Override the on function in case of sensor failure.

- 1 8. Power Supply and Slave Packs: Provide as required for sensor quantity and switching scheme.
2 Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room
3 or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.
- 4 9. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.
- 5 10. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.
- 6 11. Warranty: Five (5) year warranty.
- 7 B. Dual-Technology Type: Detect occupancy by using a combination of PIR and ultrasonic detection methods in
8 area of coverage. Particular technology or combination of technologies that controls on and off functions
9 shall be selectable in the field by operating controls on unit.
- 10 1. **[SW-VS-D] or [SW-OC-D]:** 360 Degree Coverage Pattern:
- 11 a. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to
12 activate), either technology maintains on status. Integrated ambient light level sensor (2
13 to 200 FC range), adjustable sensitivity and time delay, integrated isolated relay contact.
14 Sensor shall control all circuits in area, unless noted otherwise. Initial settings: ambient
15 sensor 40 FC.
- 16 b. Approved Manufacturers: Watt Stopper DT 300 Series, Hubbell OMNI-DT2000 or
17 ATD2000C, Greengate OAC-DT, Leviton OSC##-MOW.
- 18 2. **[SW-VS-D-W] or [SW-OC-D-W]:** Wall Mounted on Adjustable Swivel Mount:
- 19 a. Wall or ceiling sensor with adjustable settings to allow manual on/auto off or auto
20 on/auto off. Integrated ambient light level sensor (2 to 100 FC range).
- 21 b. Approved Manufacturers: Watt Stopper DT-200 Series, Hubbell LODTRP, Leviton OSM12--
22 M series.
- 23 3. **[SW-O]:** Wall Switch:
- 24 a. Wall switch with manual on/auto off. 120/277 VAC load rating of 0-800 W for ballast, LED
25 or tungsten. 5-, 15-, 30-minute adjustable OFF delay. Coverage of minor motion in 12' x
26 15' pattern.
- 27 b. Approved Manufacturers: Watt Stopper DW-100 Series, Hubbell LHMTS, Leviton OSSMT
28 series.
- 29 4. **[SW-O2]:** Wall Switch:
- 30 a. Multi-relay wall switch with manual on/auto off for two separate loads. 120/277 VAC load
31 relay rating of 0-800 W for ballast, LED or tungsten. 5-, 15-, 30-minute adjustable OFF
32 delay. Coverage of minor motion in 12' x 15' pattern.
- 33 b. Approved Manufacturers: Watt Stopper DW-200 Series, Hubbell LHMTD, Leviton OSSMD
34 series.
- 35 5. Sensitivity Adjustment: Separate for each sensing technology.
- 36 6. Detection Coverage:
- 37 a. Task Areas: Detect occupancy anywhere in an area based on hand motion.

- 1 b. Circulation Areas: Detect occupancy anywhere in an area based upon half-step walking
2 motion.
- 3 C. Mask sensors where necessary to prevent nuisance switching from adjacent areas.
- 4 D. PIR Type: Detect occupancy by sensing a combination of heat and movement in area of coverage.
- 5 1. **[SW-O]**: Wall Switch Occupancy Sensor:
- 6 a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (10 to 150 FC
7 range), adjustable sensitivity and time delay, no minimum load requirements, manual or
8 auto on operation, Initial settings: 10 minutes, ambient sensor 40 FC. Manual ON for
9 vacancy sensing.
- 10 b. Approved Manufacturers: Watt Stopper PW-100 Series, Hubbell LHIRS1 or AP1277,
11 Leviton ODS15, Greengate OSW-P-0451.
- 12 2. **[SW-O2]**: Dual Wall Switch Occupancy Sensor:
- 13 a. Passive infrared, zero crossing circuitry. Switches control two separate circuits or relays.
14 Integrated ambient light sensor (10 to 150 FC range), adjustable sensitivity and time
15 delay, no minimum load requirements, manual or auto on operation, Initial settings: 10
16 minutes, ambient sensor 40 FC. Manual ON for vacancy sensing.
- 17 b. Approved Manufacturers: Watt Stopper PW-200 Series, Hubbell LHIRD2 or AP127712,
18 Leviton ODS, Greengate OSW-P-0451.
- 19 3. **[SW-OC-P-P]**: Ceiling Mounted - 360 Degree Coverage Pattern:
- 20 a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC
21 Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall
22 control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40
23 FC.
- 24 b. Approved Manufacturers: Watt Stopper CI Series, Hubbell Automation Omni-IR, Leviton
25 OSC Series, Greengate OMR-P Series.
- 26 4. **[SW-OC-P-P2]**: Ceiling Mounted - 100 Degree Coverage Pattern:
- 27 a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC
28 Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall
29 control all circuits in the area unless noted otherwise. Initial settings: ambient sensor 40
30 FC.
- 31 b. Approved Manufacturers: Watt Stopper WPIR Series, Hubbell LOIRWV or ATD1600W.
- 32 5. **[SW-OC-P-W]**: Wall Mounted - 100 Degree Coverage Pattern:
- 33 a. Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC
34 range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall
35 control all circuits in the area unless noted otherwise. Initial settings: Ambient sensor 40
36 FC.
- 37 b. Approved Manufacturers: Watt Stopper WPIR Series, Hubbell LOIRWV or ATD1600W.
- 38 6. With daylight filter and lens to afford coverage applicable to space to be controlled.

- 1 E. Ultrasonic Type: Ceiling mounting. Detect occupancy by sensing a change in pattern of reflected ultrasonic
2 energy in area of coverage.
- 3 1. **[SW-OC-U]:** 360 Degree 20' x 20' Hand Motion Coverage Pattern:
- 4 a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral
5 isolated 1-amp relay contact, temperature and humidity resistant receivers. Sensor shall
6 control all circuits in area, unless noted otherwise.
- 7 b. Approved Manufacturers: Watt Stopper WT-1100 series, Hubbell OMNI-US or ATU series,
8 Leviton OSC series, Greengate ODC-U series.
- 9 2. **[SW-OC-U2]:** 35' x 30' Hand Motion Coverage Pattern:
- 10 a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral
11 isolated relay contact, temperature and humidity resistant receivers. Sensor shall control
12 all circuits in area, unless noted otherwise.
- 13 b. Approved Manufacturers: Watt Stopper WT-2200 series, Hubbell OMNI-US or ATU series,
14 Leviton OSC series, Greengate ODC-U series.
- 15 3. **[SW-OC-U-A]:** 360 Degree Two-Sided Corridor Coverage Pattern:
- 16 a. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral
17 isolated relay contact, temperature and humidity resistant receivers. Sensor shall control
18 all circuits in area, unless noted otherwise.
- 19 b. Approved Manufacturers: Watt Stopper WT-2250 Series, Hubbell OMNI-US or ATU series,
20 Greengate ODC-U Series.
- 21 4. **[SW-OC-U-W]:** Wall Mounted:
- 22 a. Wall switch with adjustable settings to allow manual on/auto off or auto on/auto off.
- 23 b. Approved Manufacturers: Watt Stopper UW-100 Series, Hubbell AU1277I,
- 24 5. Crystal controlled with circuitry that causes no detection interference between adjacent sensors.

25 **2.8 EMERGENCY TRANSFER DEVICES**

- 26 A. Loss of power on normal circuit shall switch load to emergency power source.
- 27 B. Provide suitable NEMA 1 enclosure and mounting per manufacturer specification.
- 28 C. **[ETD]:** Emergency Lighting Control Override - Single Luminaire:
- 29 1. Rated 2 amps at 120 volt incandescent and 10 amps at 277 volt fluorescent.
- 30 2. Approved Manufacturers: Bodine GTD, Iota ETS, Watt Stopper ELCU-100.
- 31 D. **[ETD-2]:** Emergency Lighting Control Override - Branch Loads:
- 32 1. Rated 1000 watts at 120 volt incandescent and 20 amp at 277 volt fluorescent.
- 33 2. Approved Manufacturers: Bodine GTD20, Chloride Lightstar, Dual-Lite ATSD, Nine24 ELCR, Highlites
34 HEPC.

- 1 E. **[ETD-D]:** Emergency Lighting Dimming Control Override:
- 2 1. Loss of power on normal circuit shall switch luminaires on at 100% rated light output.
- 3 2. Approved Manufacturers: Nine24 BLTCv3, nLight nPP16D (ER)

4 **2.9 TIME SWITCH**

- 5 A. **[TC-30]:** Time switch, 7-day, electronic, 30 setpoints available, LCD display, 12 or 24-hour format, minimum
- 6 200 hours battery backup, one SPDT 15-amp contact, UL listed.

- 7 1. Approved Manufacturers: Paragon EC71/30S, Tork EW101S, Intermatic ET70115C.

- 8 B. **[TC-7]:** Time switch, 7-day, 2 channel, electronic, two SPDT 15-amp contacts, two separate programs with 16
- 9 setpoints available, LCD display, 12 or 24-hour format, minimum 100 hours carry-over, UL listed.

- 10 1. Approved Manufacturers: Paragon EC72, Tork DTS 200A, Intermatic ET70215C.

11 **2.10 CONDUCTORS AND CABLES**

- 12 A. Control Wiring:

- 13 1. Where installed with the line-voltage wiring, control wiring shall be copper conductors not smaller
- 14 than No. 16 AWG with insulation voltage rating and temperature rating equal to that of the line-
- 15 voltage wiring, complying with Division 26 Section 26 05 13 "Wire and Cable."

- 16 2. Tap conductors to switches or relays: Stranded copper conductors of 16 AWG or solid 16 or 18 AWG
- 17 with insulation rating equal to that of the line-voltage wiring.

- 18 3. Tap conductors to dimming ballasts: Solid copper conductors of 18 AWG with insulation voltage
- 19 rating equal to that of the line-voltage wiring and insulation temperature rating not less than 90°C.

- 20 4. Network cabling as required by manufacturer.

- 21 B. Splices and Taps:

- 22 1. Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-
- 23 on, wire-nut type connectors are not allowed.

24 **PART 3 - EXECUTION**

25 **3.1 PRE-CONSTRUCTION MEETING**

- 26 A. Schedule a pre-construction meeting with the controls representative, installing contractor,
- 27 Architect/Engineer, and Owner to explain the proposed lighting control systems.

28 **3.2 EXAMINATION**

- 29 A. Verify that surfaces are ready to receive work.

- 30 B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of
- 31 the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.

- 32 C. Verify that required utilities are available, in proper location, and ready for use.

- 33 D. Beginning of installation means installer accepts existing conditions.

1 **3.3 INSTALLATION**

- 2 A. Install in accordance with manufacturer's instructions and approved shop drawings.
- 3 B. All wiring shall be installed in conduit.
- 4 C. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.

5 **3.4 SUPPORT SERVICES**

6 A. System Startup:

- 7 1. Manufacturer shall provide factory authorized technician to confirm proper installation and
8 operation of all system components.

9 B. Testing:

- 10 1. System shall be completely functional tested by a factory-authorized technician. All loads shall be
11 tested live for continuity and freedom from defects, and all control wiring shall be tested for
12 continuity and connections prior to energizing the system components.

- 13 2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings
14 shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall
15 serve as a basis for programming, However, all final decisions regarding groups and schedules shall
16 be at the direction of the Owner. The following procedures shall be performed at a minimum:

- 17 a. Confirm occupancy sensor placement, sensitivity, and time delay settings to meet
18 specified performance criteria.

- 19 b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet
20 specified performance criteria.

- 21 c. Confirm that schedules and time controls are configured to meet specified performance
22 criteria and Owner's operating requirements.

- 23 3. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is
24 installed in each area. Make adjustments to sensor settings and time delays to allow proper
25 operation.

- 26 4. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served
27 with no nuisance switching.

- 28 a. Relocate sensors or provide additional sensors as necessary to provide adequate
29 coverage.

- 30 b. Mask occupancy sensors where necessary to prevent nuisance switching from adjacent
31 areas.

32 C. Training:

- 33 1. Manufacturer shall provide competent factory-authorized technician to train Owner personnel in
34 the operation, maintenance and programming of the lighting control system. Submit training plan
35 with notification seven (7) days prior to proposed training dates.

- 36 2. Training duration shall be no less than three (3) days, with one (1) day being scheduled at least two
37 (2) weeks after initial training.

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Service and distribution panelboards: [DP-#]
- B. Lighting and appliance branch circuit panelboards: [Panel '###']
- C. Fusible branch circuit panelboards: [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.

- 1 2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry
2 a minimum of the AIC rating that is specified.
- 3 B. The panelboards for this project shall be fully rated.
- 4 **2.2 MAIN AND DISTRIBUTION PANELBOARDS**
- 5 A. General
- 6 1. Approved Manufacturers:
- 7 a. Square D QMB, I-Line
8 b. General Electric Spectra ADS
9 c. Siemens F2, P4
10 d. Cutler Hammer PRL4, PRL5
- 11 B. Panelboards: NEMA PB 1; type as shown on the drawings.
- 12 C. Enclosure: NEMA PB 1; Type 1.
- 13 D. Provide cabinet front with concealed trim clamps and hinged trim on door to allow access to wiring gutters
14 without removal of trim and flush lock. Finish in manufacturer's standard gray enamel.
- 15 E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all
16 panelboards.
- 17 F. All spaces shown on the one-line diagram shall be fully prepared spaces for future breakers.
- 18 G. Minimum Integrated Short Circuit Rating: 100,000 amperes rms symmetrical for 240-volt panelboards; 50,000
19 amperes rms symmetrical for 480-volt panelboards, or as shown on the drawings.
- 20 H. Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch with
21 externally operable handle. Provide interlock to prevent opening front cover with switch in ON position.
22 Handle lockable in OFF position.
- 23 I. Fuse Clips (Switches 600 Amperes and Smaller): Provide with Class 'R' rejection clips. Fuse Clips (601 Amperes
24 and Larger): Designed to accommodate Class 'L' fuses.
- 25 J. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip
26 in each pole.
- 27 K. Solid State Molded Case Circuit Breakers: **(All breakers identified on plans as solid-state with 1,200 ampere
28 frame sizes and below.)** Provide molded case switch with electronic sensing, timing, and tripping circuits for
29 fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time
30 trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with a
31 sealable clear cover.
- 32 L. Arc Energy Reduction:
- 33 1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc
34 energy reduction system shall be provided for overcurrent protection devices rated 1,200 amps or
35 larger.
- 36 2. Energy-Reducing Maintenance Switch: Provide an energy-reducing maintenance switch visual
37 status indication when engaged. Install the maintenance switch in the first section of the electrical
38 equipment.
- 39 M. Suitable for use as service entrance equipment.

- 1 N. **[DPM]:** Digital Power Meter:
- 2 1. The following instantaneous readings shall be monitored, displayed, and communicated
- 3 by the power meter:
- 4 a. Frequency, monthly maximum and minimum
- 5 b. Current, per phase RMS, 3-phase average RMS, apparent RMS, peak demand
- 6 (15-minute sliding window)
- 7 c. Voltage, phase-to-phase and phase-to-neutral
- 8 d. Power factor, per phase and 3-phase total
- 9 e. Real power (kW), 3-phase total, peak demand, cumulative (kWH)
- 10 f. Reactive power (kVAR), 3-phase total
- 11 g. Total harmonic distortion (current and voltage)
- 12 2. The current and voltage signals shall be digitally sampled at a rate high enough to provide
- 13 true-RMS sensing through the 31st harmonic. All setup parameters required by the power
- 14 meter shall be stored in nonvolatile memory and retained in the event of a control power
- 15 interruption. The meter shall maintain, in nonvolatile memory, maximum and minimum
- 16 values for each of the instantaneous values reported, as well as the time and date of the
- 17 highest peak for all peak demand readings.
- 18 3. The power meter shall be equipped with a display to provide local access to all metered
- 19 quantities.
- 20 4. Reset of the following electrical parameters shall also be allowed from the front of the
- 21 display or energy meter:
- 22 a. Peak demand current
- 23 b. Peak demand power
- 24 c. Energy (MWH)
- 25 d. Reactive energy (MVARH)
- 26 5. Waveform Capture Capability: Waveform capture shall be for three (3) cycles and
- 27 initiated manually using software.
- 28 6. The data points shall be sampled in a manner that allows the original power signals with
- 29 proper magnitude and phase relationships to be reconstructed. Reconstruction of the
- 30 original power signal from the stored data points shall have sufficient accuracy to allow
- 31 steady-state power harmonic analysis that provides valid information on harmonic
- 32 content for up to the 81st harmonic of the fundamental power frequency.
- 33 7. The power meter shall have one (1) digital input and one (1) digital solid state output/KY
- 34 pulse output.
- 35 8. The power meter shall be provided with a six (6) digital input and two (2) digital output
- 36 (relay) output accessory card.
- 37 9. The meter shall interface with the Facilities Management and Control System via BACnet.
- 38 Coordinate interface and connection requirements with TCC.
- 39 10. Approved Manufacturers: Square D Power Logic PM850, Cutler Hammer, Siemens
- 40 PAC9360, General Electric EPM9450.

- 1 **2.3 BRANCH CIRCUIT PANELBOARDS**
- 2 A. General
- 3 1. Approved Manufacturers:
- 4 a. Square D NQ, NF
- 5 b. General Electric AQ, AE
- 6 c. Siemens P1
- 7 d. Cutler Hammer PRL1, PRL2
- 8 B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.
- 9 C. Enclosure: NEMA PB 1; Type 1.
- 10 D. Provide cabinet front with door-in-door construction, concealed hinge, and flush lock all keyed alike. Finish
11 in manufacturer's standard gray enamel.
- 12 E. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all
13 panelboards.
- 14 F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future breakers.
- 15 G. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.
- 16 H. Minimum Integrated Short Circuit Rating: As shown on the drawings.
- 17 I. Provide handle lock-on devices for all breakers serving exit sign and lighting circuits with emergency battery
18 units. Provide handle lock-on devices and red handles for breakers serving fire alarm panels.
- 19 J. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle
20 for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground
21 fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.
- 22 K. Current Limiting Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and
23 instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements
24 in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than
25 permitted for same size Class RK-5 fuse.
- 26 **2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS**
- 27 A. General
- 28 1. Approved Manufacturers:
- 29 a. Bussmann
- 30 b. Littelfuse
- 31 c. Mersen MFCP
- 32 B. Provide cabinet front with concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard
33 gray enamel.
- 34 C. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all
35 panelboards.
- 36 D. Overcurrent protective devices shall be UL listed, with voltage, amperage, number of poles, and short-circuit
37 current rating as shown on the panelboard schedule. Multi-pole branch circuit protection devices shall trip
38 on an overcurrent of any pole to prevent single-phasing of the load.

- 1 E. Fuse holder shall be finger-safe with trim installed. Fuses shall only be removable when terminals are not
2 energized.
- 3 F. All unlabeled circuits shown on the panelboard schedule shall be fully prepared spaces for future fuse units.
- 4 G. All multiple-section panelboards shall have the same dimensional backbox and cabinet front size.
- 5 H. Minimum Integrated Short Circuit Rating: As shown on the drawings.
- 6 I. Branch fuse disconnect shall have visible ON/OFF indication, blown fuse indicating lights, and permanently
7 installed lockout means.

8 **PART 3 - EXECUTION**

9 **3.1 INSTALLATION**

- 10 A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.
- 11 B. Height: 6 feet to handle of highest device.
- 12 C. Provide filler plates for unused spaces in panelboards.
- 13 D. Provide typed circuit directory for each branch circuit panelboard. Label each circuit with the type of load and
14 the name and number of the area served. Revise directory to reflect circuit changes required to balance phase
15 loads.
- 16 E. Stub five (5) empty one-inch conduits to accessible location above ceiling out of each recessed panelboard.
- 17 F. Install fuses in fusible switch assemblies.

18 **3.2 FIELD QUALITY CONTROL**

- 19 A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard
20 between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within
21 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- 22 B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding.
23 Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

24 **END OF SECTION**

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

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.
- 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 **1.6 DELIVERY, STORAGE, AND HANDLING**

- 2 A. Deliver products to site under provisions of Section 26 05 00.
- 3 B. Deliver in 60-inch maximum width shipping splits, individually wrapped for protection, and mounted on
4 shipping skids.
- 5 C. Store and protect products under provisions of Section 26 05 00.
- 6 D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy
7 plastic cover to protect units from fumes, dirt, water, construction debris, traffic, and physical damage.
- 8 E. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose.
9 Handle carefully to avoid damage to motor control center components, enclosure, and finish.

10 **1.7 OPERATION AND MAINTENANCE DATA**

- 11 A. Submit operation and maintenance data under provisions of Section 26 05 00.
- 12 B. Include spare parts data listing; source and current prices of replacement parts and supplies; and
13 recommended maintenance procedures and intervals.

14 **PART 2 - PRODUCTS**

15 **2.1 MANUAL MOTOR STARTERS**

- 16 A. Manual Motor Starter: NEMA ICS 2; AC general-purpose Class A manually operated non-reversing
17 full-voltage controller for induction motors rated in horsepower, with overload relay, and toggle operator.
- 18 B. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated,
19 full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle
20 operator.
- 21 C. Motor Starting Switch: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller
22 for fractional horsepower induction motors, without thermal overload unit, and toggle operator.
- 23 D. Enclosure: NEMA ICS 6; Type 1.

24 **2.2 MAGNETIC MOTOR STARTERS**

- 25 A. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose Class A magnetic controller for induction motors
26 rated in horsepower.
- 27 B. Full Voltage Starting: Non-reversing type, unless otherwise indicated.
- 28 C. Coil Operating Voltage: 120 volts, 60 Hertz, obtained from integral control power transformer of sufficient
29 capacity to operate connected pilot, indicating, and control devices, plus 100% spare capacity.
- 30 D. Size: NEMA ICS 2; size as shown on the drawings.
- 31 E. Overload Relay:
- 32 1. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA
33 ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to
34 nameplate full-load current of specific motor to which they connect and with appropriate
35 adjustment for duty cycle.

- 1 F. Enclosure: NEMA ICS 6; Type 1.
- 2 G. Combination Motor Starters: Combine motor starters with disconnect switch in common enclosure. Provide
3 with disconnecting means as indicated on drawings.
- 4 H. Auxiliary Contacts: NEMA ICS 2; two normally open, field convertible contacts in addition to seal-in contact.
- 5 I. Pushbuttons: NEMA ICS 2; START/STOP in front cover.
- 6 J. Indicating Lights: NEMA ICS 2; RUN: red in front cover.
- 7 K. Selector Switches: NEMA ICS 2; HAND/OFF/AUTO, in front cover.
- 8 L. Relays: NEMA ICS 2.
- 9 M. Control Power Transformers: 120 volt fused secondary, fused primary, minimum VA as scheduled:
10 Size 1 - 100 VA
11 Size 2 - 100 VA
12 Size 3 - 150 VA
13 Size 4 - 300 VA
14 Size 5 - 300 VA
15 Size 6 - 300 VA
- 16 N. Provide phase loss protection relay with contacts to de-energize the starter for each starter serving motors
17 5 HP or greater.
- 18 **2.3 CONTROLLER OVER-CURRENT PROTECTION AND DISCONNECTING MEANS**
- 19 A. Molded Case Thermal-Magnetic Circuit Breakers: Circuit breakers with integral thermal and instantaneous
20 magnetic trip in each pole. NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip
21 coordinated with motor locked-rotor amperes.
- 22 B. Non-fusible Switch Assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with
23 externally operable handle. Provide interlock to prevent opening front cover with switch in ON position.
24 Handle lockable in OFF position.
- 25 C. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with
26 externally operable handle. Provide interlock to prevent opening front cover with switch in ON position.
27 Handle lockable in OFF position. Fuse Clips: Provide with Class 'R' rejection clips. Select and size fuses to
28 provide Type 2 protection according to IEC 947-4-1, as certified by a nationally recognized testing
29 laboratory.

30 **PART 3 - EXECUTION**

31 **3.1 INSTALLATION**

- 32 A. Install motor control equipment in accordance with manufacturer's instructions on concrete bases.
- 33 B. Install fuses in fusible switches.
- 34 C. Select and install heater elements in motor starters to match installed motor characteristics.
- 35 D. Set field-adjustable switches and circuit-breaker trip ranges.

1 E. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served,
2 nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3 F. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

4 **END OF SECTION**

1 **SECTION 26 27 26**
2 **WIRING DEVICES**

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Device plates and box covers
- 6 B. Receptacles
- 7 C. Modular power distribution system
- 8 D. Pendant cord/connector devices
- 9 E. Cord and plug sets
- 10 F. Power pedestals

11 **1.2 QUALITY ASSURANCE**

- 12 A. Provide similar devices from a single manufacturer.
- 13 B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the NEC Article 100, by a
14 testing agency to Authorities Having Jurisdiction and marked for intended use.
- 15 C. Comply with the NEC.

16 **1.3 REFERENCES**

- 17 A. DSCC W-C-896F – General Specification for Electrical Power Connector
- 18 B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- 19 C. NEMA WD 1 – General Color Requirements for Wiring Devices
- 20 D. NEMA WD 6 – Wiring Devices – Dimensional Requirements
- 21 E. NFPA 70 - National Electrical Code (NEC)
- 22 F. UL 498 – Standard for Attachment Plugs and Receptacles
- 23 G. UL 943 – Standard for Ground Fault Circuit Interrupters

24 **1.4 SUBMITTALS**

- 25 A. Submit product data under provisions of Section 26 05 00.
- 26 B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.
- 27 C. Submit manufacturer occupancy sensor coverage patterns applicable to this project. For areas requiring
28 multiple sensor devices for appropriate coverage, submit specific manufacturer approved sensor layout as an
29 overlay directly on the project drawings, either in print or approved electronic form.

30 **1.5 COORDINATION**

- 31 A. Receptacles for Owner Furnished Equipment: Match plug configurations.
- 32 B. Cord and Plug Sets: Match equipment requirements.

33 **PART 2 - PRODUCTS**

34 **2.1 DEVICE COLOR**

- 35 A. All switch, receptacle, outlet, and coverplate colors shall be white, unless indicated otherwise.

1 **2.2 COVERPLATES**

- 2 A. All switches, receptacles, and outlets shall be complete with the following:
- 3 1. Unbreakable thermoplastic/thermoset plastic coverplates in finished spaces where walls are
4 finished.
- 5 2. #302 stainless steel coverplates in unfinished spaces for flush boxes.
- 6 3. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.
- 7 B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of
8 devices used.
- 9 C. Install nameplate identification as indicated in Section 26 05 53.
- 10 D. Plate securing screws shall be metal with head color matching the wall plate finish.

11 **2.3 RECEPTACLES**

- 12 A. Refer to Electrical Symbols List for device type.
- 13 B. Devices that are shaded on the drawings shall be red.
- 14 C. **[REC-DUP]:** NEMA 5-20R Duplex Receptacle:
- 15 1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back
16 strap.
- 17 2. Approved Manufacturers: Hubbell 5352A, Leviton, 5362-S, Pass & Seymour 5362, Cooper 5352.
- 18 D. **[REC-DUP-GFI]:** NEMA 5-20R Ground Fault Duplex Receptacle:
- 19 1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant
20 thermoplastic face.
- 21 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
- 22 3. Approved Manufacturers: Hubbell GF20L, Leviton GFNT2, Pass & Seymour 2097, Cooper SGF20.
- 23 E. **[REC-DUP-GFI-R]:** Remote Ground Fault Device:
- 24 1. Ground fault device for remote downstream receptacles. 125-volt, 20 amp. Test and reset buttons
25 in impact resistance thermoplastic face.
- 26 2. Approved Manufacturers: Hubbell GFBF20, Leviton 6895, Pass & Seymour 2085, Cooper VGFD20.
- 27 F. **[REC-DUP-WP]:** NEMA 5-20R Weatherproof Ground Fault Duplex Receptacle:
- 28 1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant
29 thermoplastic face. Provide NEMA 3R rated while-in-use cast aluminum cover.
- 30 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
- 31 3. Approved Manufacturers: Hubbell GFTR20/(RW57300) WP826, Leviton GFWT2/(5977-CL) M5979,
32 Pass & Seymour 2097TRWR/(WIUC10-C) WIUCAST1, Cooper WRSFG20/(WIU-1) WIUMV-1.

- 1 G. **[REC-USB]:** NEMA 5-20R Receptacle with USB Charger:
- 2 1. 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face.
3 Type A USB charging rated at 5VDC 2.1A. Mounted in double gang backbox.
- 4 2. Approved Manufacturers: Hubbell USB20X2, Pass & Seymour TR5362USB, Cooper TR7766.
- 5 H. **[REC-SIM-520R]:** NEMA 5-20R Simplex Receptacle:
- 6 1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.
- 7 2. Approved Manufacturers: Hubbell HBL5361, Leviton, 5361, Pass & Seymour 5361, Cooper 5361.
- 8 I. **[REC-SIM-530R]:** NEMA 5-30R Simplex Receptacle:
- 9 1. 125-volt, 30 amp, 3-wire grounding type, phenolic face.
- 10 2. Approved Manufacturers: Hubbell HBL9308, Leviton 5371, Pass & Seymour 3802, Cooper 5716N.
- 11 J. **[REC-SIM-550R]:** NEMA 5-50R Simplex Receptacle:
- 12 1. 125-volt, 50 amp, 3-wire grounding type, phenolic face.
- 13 2. Approved Manufacturers: Hubbell HBL9360, Cooper 1253.
- 14 K. **[REC-SIM-620R]:** NEMA 6-20R Simplex Receptacle:
- 15 1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 16 2. Approved Manufacturers: Hubbell HBL5461, Leviton 5461, Pass & Seymour 5871, Cooper 5461.
- 17 L. **[REC-SIM-630R]:** NEMA 6-30R Simplex Receptacle:
- 18 1. 250-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 19 2. Approved Manufacturers: Hubbell HBL9330, Leviton 5372, Pass & Seymour 3801, Cooper 5700N.
- 20 M. **[REC-SIM-650R]:** NEMA 6-50R Simplex Receptacle:
- 21 1. 250-volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 22 2. Approved Manufacturers: Hubbell HBL9367, Leviton 5374, Pass & Seymour 3804, Cooper 5709N.
- 23 N. **[REC-SIM-720R]:** NEMA 7-20R Simplex Receptacle:
- 24 1. 277-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 25 2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour 7621.
- 26 O. **[REC-SIM-730R]:** NEMA 7-30R Simplex Receptacle:
- 27 1. 277-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 28 2. Approved Manufacturers: Hubbell HBL9315, Leviton 9730-A, Pass & Seymour, Cooper 5795N.

- 1 P. **[REC-SIM-750R]**: NEMA 7-50R Simplex Receptacle:
- 2 1. 277-volt, 50 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 3 2. Approved Manufacturers: Hubbell HBL9365, Leviton 9750-A, Pass & Seymour, Cooper.
- 4 Q. **[REC-SIM-1420R]**: NEMA 14-20R Simplex Receptacle:
- 5 1. 125/250-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
- 6 2. Approved Manufacturers: Hubbell HBL8410, Pass & Seymour 3820, Cooper 5759.
- 7 R. **[REC-SIM-1430R]**: NEMA 14-30R Simplex Receptacle:
- 8 1. 125/250-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +24
- 9 AFF.
- 10 2. Approved Manufacturers: Hubbell HBL9430A, Leviton 278, Pass & Seymour 3864, Cooper 5744N.
- 11 S. **[REC-SIM-1450R]**: NEMA 14-50R Simplex Receptacle:
- 12 1. 125/250-volt, 50 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +4"
- 13 AFF.
- 14 2. Approved Manufacturers: Hubbell HBL9450A, Leviton 279, Pass & Seymour 3894, Cooper 5754N.
- 15 T. **[REC-SIM-1460R]**: NEMA 14-60R Simplex Receptacle:
- 16 1. 125/250-volt, 60 amp, 3-pole, 4-wire grounding type with thermoplastic face.
- 17 2. Approved Manufacturers: Hubbell HBL9460A, Leviton 9460, Pass & Seymour, Cooper 9460N.
- 18 U. **[REC-SIM-1520R]**: NEMA 15-20R Simplex Receptacle:
- 19 1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
- 20 2. Approved Manufacturers: Hubbell HBL8420, Leviton, Pass & Seymour, Cooper.
- 21 V. **[REC-SIM-1530R]**: NEMA 15-30R Simplex Receptacle:
- 22 1. 250-volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
- 23 2. Approved Manufacturers: Hubbell HBL8430A, Leviton 8430, Pass & Seymour 5740, Cooper 8430N.
- 24 W. **[REC-SIM-1550R]**: NEMA 15-50R Simplex Receptacle:
- 25 1. 250-volt, 50 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
- 26 2. Approved Manufacturers: Hubbell HBL8450A, Leviton 8450, Pass & Seymour 5750, Cooper 8450N.
- 27 X. **[REC-SIM-1560R]**: NEMA 15-60R Simplex Receptacle:
- 28 1. 250-volt, 60 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
- 29 2. Approved Manufacturers: Hubbell HBL9460A, Pass & Seymour 5760, Cooper 8460N.

- 1 Y. **[REC-SIM-L520R]:** NEMA L5-20R Simplex Receptacle, Locking Type:
- 2 1. 125-volt, 20 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.
- 3 2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L520, Cooper CWL520R.
- 4 Z. **[REC-SIM-L530R]:** NEMA L5-30R Simplex Receptacle Locking Type:
- 5 1. 125-volt, 30 amp, 2-pole, 3-wire grounding type with impact resistant thermoplastic face.
- 6 2. Approved Manufacturers: Hubbell, Leviton, Pass & Seymour L530, Cooper CWL530R.
- 7 AA. **[REC-SIM-L620R]:** NEMA L6-20R Locking Type Simplex Receptacle:
- 8 1. 250-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 9 2. Approved Manufacturers: Hubbell HBL2320, Leviton 2320, Pass & Seymour L620R, Cooper
- 10 CWL620R.
- 11 BB. **[REC-SIM-L630R]:** NEMA L6-30R Locking Type Simplex Receptacle:
- 12 1. 250-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 13 2. Approved Manufacturers: Hubbell HBL2620, Leviton 2620, Pass & Seymour L630R, Cooper
- 14 CWL630R.
- 15 CC. **[REC-SIM-L720R]:** NEMA L7-20R Locking Type Simplex Receptacle:
- 16 1. 277-volt, 20 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 17 2. Approved Manufacturers: Hubbell HBL2330, Leviton 2330, Pass & Seymour L720R, Cooper
- 18 CWL720R.
- 19 DD. **[REC-SIM-L730R]:** NEMA L7-30R Locking Type Simplex Receptacle:
- 20 1. 277-volt, 30 amp, 2-pole, 3-wire grounding type with thermoplastic face.
- 21 2. Approved Manufacturers: Hubbell HBL2630, Leviton 2630, Pass & Seymour L730R, Cooper
- 22 CWL730R.
- 23 EE. **[REC-SIM-L1420R]:** NEMA L14-20R Locking Type Simplex Receptacle:
- 24 1. 125/250-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
- 25 2. Approved Manufacturers: Hubbell HBL 2410, Pass & Seymour L1420, Cooper CWL1420R.
- 26 FF. **[REC-SIM-L1430R]:** NEMA L14-30R Locking Type Simplex Receptacle:
- 27 1. 125/250-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.
- 28 2. Approved Manufacturers: Hubbell HBL 2710, Leviton 2710, Pass & Seymour L1430R, Cooper
- 29 CWL1430R.
- 30 GG. **[REC-SIM-L1520R]:** NEMA L15-20R Locking Type Simplex Receptacle:
- 31 1. 250-volt, 20 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.

- 1 2. Approved Manufacturers: Hubbell HBL2420, Leviton 2420, Pass & Seymour L1520R, Cooper
2 CWL1520R.
- 3 HH. **[REC-SIM-L1530R]:** NEMA L15-30R Locking Type Simplex Receptacle:
- 4 1. 250-volt, 30 amp, 3-phase, 3-pole, 4-wire grounding type with thermoplastic face.
- 5 2. Approved Manufacturers: Hubbell HBL2720, Leviton 2720, Pass & Seymour L1530R, Cooper
6 CWL1530R.
- 7 II. **[REC-SIM-L1620R]:** NEMA L16-20R Locking Type Simplex Receptacle:
- 8 1. 480-volt, 20 amp, 3-pole, 4-wire grounding type with thermoplastic face.
- 9 2. Approved Manufacturers: Hubbell HBL2431, Pass & Seymour L1620R, Cooper CWL1620R.
- 10 JJ. **[REC-SIM-L1630R]:** NEMA L16-30R Locking Type Simplex Receptacle:
- 11 1. 480-volt, 30 amp, 3-pole, 4-wire grounding type with thermoplastic face.
- 12 2. Approved Manufacturers: Hubbell HBL2730, Leviton 2730, Pass & Seymour L1630R, Cooper
13 CWL1630R.
- 14 KK. **[REC-SIM-L2120R]:** NEMA L21-20R Locking Type Simplex Receptacle:
- 15 1. 120/208Y 3 phase 20-amp 5 wire grounding type.
- 16 2. Approved Manufacturers: Hubbell HBL2510, Cooper CWL2120R, Pass & Seymour L2120R.
- 17 LL. **[REC-SIM-L2130R]:** NEMA L21-30R Locking Type Simplex Receptacle:
- 18 1. 120/208Y 3 phase 30-amp 5 wire grounding type.
- 19 2. Approved Manufacturers: Hubbell HBL2750, Cooper CWL2130R, Pass & Seymour L2130R.
- 20 MM. **[REC-TAMP]:** NEMA 5-20R Tamper Resistant Duplex Receptacle:
- 21 1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.
- 22 2. Approved Manufacturers: Hubbell BR20TR, Leviton TBR20, Pass & Seymour TR5362, Cooper
23 TRBR20.
- 24 3. Provide decorative style duplex tamper resistant receptacles in public spaces where walls are
25 finished.
- 26 4. Approved Manufacturers: (Decorative), Hubbell DR20TR, Leviton TDR20, Pass & Seymour TR2635.
- 27 NN. **[REC-TAMP-GFI]:** NEMA 5-20R GFI Tamper Resistant Receptacle:
- 28 1. 125-volt, 20 amp, 3-wire grounding type tamper-resistant with test and reset buttons in impact
29 resistant thermoplastic face.
- 30 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
- 31 3. Approved Manufacturers: Hubbell GFTR20, Cooper TRSGF20, Pass & Seymour 2097TR, Leviton
32 GFTR2.

- 1 OO. **[REC-TAMP-QUAD]:** NEMA 5-20R Double Duplex Tamper Resistant Receptacle:
- 2 1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.
- 3 2. Approved Manufacturers: Refer to Tamper Resistant Receptacle above.
- 4 PP. **[REC-DUP-O]:** NEMA 5-20R Plug Load Controlled Duplex Receptacle:
- 5 1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back
- 6 strap. Bottom half of duplex shall be split circuit wired and controlled by remote relay. Controlled
- 7 receptacle shall have permanent NEMA approved and NEC 2014 compliant marking on face of
- 8 device.
- 9 2. Approved Manufacturers: Pass & Seymour 5362H, Leviton 5362-1P, Hubbell, Cooper.
- 10 QQ. **[REC-QUAD-O]:** NEMA 5-20R Plug Load Controlled Duplex Receptacle:
- 11 1. Consists of two duplex tamper resistant receptacles, double gang box, plaster ring and faceplate.
- 12 2. Approved Manufacturers: Refer to Plug Load Controlled Duplex Receptacles above.
- 13 RR. **[REC-QUAD]:** NEMA 5-20R Double Duplex Receptacle:
- 14 1. Consists of two duplex receptacles, double gang box, plaster ring and faceplate.
- 15 2. Approved manufacturers: Refer to Duplex Receptacle above.
- 16 SS. **[REC-QUAD-GFI]:** NEMA 5-20R Double Duplex GFI Receptacle:
- 17 1. Consists of two duplex GFI receptacles, double gang box, plaster ring and faceplate.
- 18 2. Approved Manufacturers: Refer to Duplex GFI Receptacle above.
- 19 TT. **[REC-QUAD-USB]:** NEMA 5-20R Double Duplex USB Receptacle:
- 20 1. Consists of two duplex USB receptacles, double gang box, plaster ring and faceplate.
- 21 2. Approved Manufacturers: Refer to USB Receptacle above.
- 22 UU. **[REC-QUAD-WP]:** NEMA 5-20R Weatherproof Ground Fault Quad Receptacle:
- 23 1. Consists of two duplex, GFI receptacles. Double gang box. Provide NEMA 3R rated while-in-use cast
- 24 aluminum cover.
- 25 2. Approved Manufacturers:
- 26 a. Receptacle: Refer to GFCI Receptacle above.
- 27 b. Cover: Intermatic WP1030MXD, Pass & Seymour WIUCAST2, Thomas & Betts Red Dot
- 28 2CKU.
- 29 VV. Back wired devices shall be complete with eight holes that are screw activated with metal clamps for
- 30 connection to #12 or #10 copper conductors.
- 31 WW. Side wired devices shall have four binding screws that are undercut for positive wire retention.

1 XX. Ground fault circuit interrupter (GFCI) receptacles shall comply with UL 943 requiring increased surge
2 immunity, improved corrosion resistance, improved resistance to false tripping and diagnostic indication for
3 miswiring if the line and load conductors are reversed during installation.

4 **2.4 MODULAR POWER DISTRIBUTION SYSTEM**

5 A. Approved Manufacturers:

- 6 1. Wiremold Walkerflex
- 7 2. Communications Integrators, Inc. (CII)
- 8 3. Tyco ACS/Uni-fab

9 B. General system description:

- 10 1. The system shall be installed under all raised access floor areas identified on architectural plans and
11 shall consists of power distribution boxes, homerun MC cables, various MC branch circuit cables,
12 and access floor boxes with plug-and-play quick disconnect modular ports to allow for simple
13 remodeling.
- 14 2. All system components shall be supplied from a single manufacturer to ensure component
15 compatibility.
- 16 3. System capacity: Provide a quantity of system components sufficient to serve all 208V and 120V
17 receptacles circuits shown on plans. Provide an additional 25% spare capacity per distribution box,
18 or a minimum of one (1) circuit of each branch type in space, whichever method results in more
19 circuits. Spare capacity shall be installed from panelboard to distribution box and shall be evenly
20 distributed throughout the entire space served.

21 C. Components – Modular Power System

22 1. Homerun Cables:

- 23 a. Construction: Metal clad (MC) cable containing multiple #10 AWG THHN, 90°C copper
24 phase conductors, dedicated neutrals, equipment ground. Provide color-coded wires for
25 easy visual identification. Increase conductor size for runs where the branch circuit
26 voltage drop exceeds 3%.
- 27 b. Quantity of homerun cables shall be based on quantity of distribution boxes and system
28 structure.

29 2. Main Distribution Boxes:

- 30 a. Construction: Cold-rolled steel enclosure with four (4) leg mounting supports to elevate
31 box off concrete floor. The box shall contain factory installed wiring blocks on a terminal
32 strip for field use.
- 33 b. Provide knock-out(s) for hardwired input connection to homerun conductors. Box shall
34 either accept feeders from two panels, or two separate boxes shall be provided.
- 35 c. Boxes shall have multiple modular output connections (simplex or duplex) for branch
36 circuit cables connection.
- 37 d. A primary/secondary distribution box layout is acceptable.
- 38 e. Provide permanent label on top of box indicating panel source(s) and circuit number.

- 1 3. Branch Circuit Cables:
- 2 a. Construction: Metal clad (MC) cable containing multiple, #10 or #12 AWG THHN, 90°C
- 3 minimum-rated copper phase conductors. Length and wire size as required per end
- 4 device physical location in building. Increase conductor size for runs where the branch
- 5 circuit voltage drop exceeds 3%.
- 6 b. Provide a locking, modular pin and socket connection on both ends of cables serving
- 7 access floor boxes.
- 8 c. Cables shall be able to be connected together to provide additional length for future
- 9 remodeling.
- 10 d. Length: Suitable to reach device served. All cables serving floor boxes shall have a 10 foot
- 11 (3 meter) slack loop to allow for quick relocation.
- 12 e. Maximum combined cable length from distribution box shall not exceed 50 feet (15
- 13 meters).
- 14 4. Access Floor Boxes:
- 15 a. Construction: Steel box with galvanized exterior. Thermoplastic lid with “mouse holes”
- 16 that allow cables to exit box with lid fully closed. Lid shall be able to accept carpet or vinyl
- 17 insert. Multi-service type (power/technology). All receptacles installed in floor box shall
- 18 match the specified wall receptacle quality.
- 19 b. Provide input and output modular connection ports on box that allow for “daisy-chaining”
- 20 of floor boxes sharing common circuits.
- 21 c. Maximum depth of floorbox from walking surface: 5 inches (130mm).
- 22 d. **[FB-1]:** Provide with (1) circuit to (2) [REC-DUP] and (2) gangs of space for low voltage
- 23 devices, including voltage divider.
- 24 e. **[FB-2]:** Provide with (2) circuits to (4) [REC-DUP] and (2) gangs of space for low voltage
- 25 devices, including voltage divider.
- 26 5. Furniture feeds:
- 27 a. **[FF-1]:** Distribution unit to connect to powered furniture with circuits shown on plans.
- 28 Coordinate exact requirements with powered furniture.
- 29 6. Accessories:
- 30 a. Provide all miscellaneous accessories and connectors required to create a complete and
- 31 functioning system.

32 D. Coordinate with Technology drawings for voice/data outlet requirements.

33 **2.5 PENDANT CORD/CONNECTOR DEVICES**

34 A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, Configurations L5-20P

35 and L5-20R, heavy-duty grade or refer to Details as shown on drawings.

36 1. Body: Nylon with screw-open cable gripping jaws and provisions for attaching external cable grip.

1 B. External Cable Grip: Woven wire mesh type made of high strength galvanized steel wire stand, matched to
2 cable diameter, and with attachment provision designed for corresponding connector.

3 **2.6 CORD AND PLUG SETS**

4 A. Description: Match voltage and current ratings and number of conductors to requirements of equipment
5 being connected.

6 1. Cord: Rubber-insulated, stranded copper conductors, with Type SOW-A jacket; with green insulated
7 grounding conductor and equipment rating ampacity plus a minimum of 30 percent.

8 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection,
9 FS/UL listed.

10 **2.7 POWER PEDESTALS**

11 A. [PP-1]: Outdoor power pedestal. ADA compliant, 22.5" tall aluminum construction pedestal with recessed
12 device mounting and wet location, while in use, cover. Four (4) NEMA 5-20R weather resistant GFCI duplex
13 receptacles to match those in [REC-DUP-WP]. Pedestal base shall have space for two conduit stubs with a
14 low voltage divider for future low voltage wiring. Powder coat finish selection by architect from custom
15 manufacturer color options.

16 1. Approved Manufacturers:

17 a. Cole Lighting TL410-WCS-PED

18 **PART 3 - EXECUTION**

19 **3.1 INSTALLATION**

20 A. Install light switches, dimmers, and convenience receptacles at elevations indicated in the General Installation
21 Notes on the contract drawings.

22 B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and
23 square with building lines. Coordinate installation of adjacent devices of separate systems with common
24 mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.

25 C. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions. This
26 Contractor is responsible for taking any measures required to ensure no conduits or other services are
27 damaged. This may include X-ray or similar non-destructive means.

28 D. Install receptacles vertically with ground slot up or where indicated on the drawings, horizontally with ground
29 slot to the left.

30 E. Install decorative plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for
31 outlets installed in masonry walls.

32 F. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible
33 ceilings, and on surface-mounted outlets.

34 G. Install devices and wall plates flush and level.

35 H. Contractor to verify that wall dimmer ratings are achieved where a ganged installation is used.

36 I. Install nameplate identification to receptacle cover plates indicated. Identification shall identify panel name
37 and circuit number. Refer to Specification Section 26 05 53 - Electrical Identification.

- 1 J. Identify locations of power packs, control units, and relays above ceiling on record drawing.
- 2 K. Test receptacles for proper polarity, ground continuity and compliance with requirements.
- 3 L. Healthcare devices shall be tested in accordance with NFPA 99 6.3.3 for grounding, voltage, and impedance
4 measurements.
- 5 M. Floor Box Installation:
- 6 1. Set boxes level and flush with finish flooring material.
- 7 2. Use cast iron floor boxes for installations in slab on grade. Trim shall match floor covering to be
8 used.
- 9 3. Provide a minimum horizontal offset of 24 inches between boxes.
- 10 4. Provide saw-cutting and patching of existing concrete floors as necessary for floor box installations
11 within existing floors.

12 **END OF SECTION**

SECTION 26 28 13
FUSES

1
2

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Fuses
6 B. Spare Fuse Cabinet

7 **1.2 REFERENCES**

- 8 A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types
9 B. UL 198E - Class R Fuses
10 C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)
11 D. NEMA FU 1 - Low Voltage Cartridge Fuses
12 E. NFPA 70 – National Electrical Code

13 **1.3 SUBMITTALS**

- 14 A. Submit product data under provisions of Section 26 05 00.

15 **1.4 EXTRA MATERIALS**

- 16 A. Provide two fuse pullers.
17 B. Provide three of each size and type of fuse installed.

18 **1.5 PROJECT CONDITIONS**

- 19 A. Where ambient temperature to which fuses are directly exposed is less than 40°F (5°C) or more than 100°F
20 (38°C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

21 **PART 2 - PRODUCTS**

22 **2.1 ACCEPTABLE MANUFACTURERS – FUSES**

- 23 A. Cooper Bussman
24 B. Eagle Electric Mfg. Co.; Cooper Industries
25 C. Mersen
26 D. Tracor; Littelfuse Subsidiary

27 **2.2 FUSES**

- 28 A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
29 B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
30 C. Fuses with ratings larger than 600 amperes: Class L (time delay), unless otherwise noted on the drawings.
31 D. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay),
32 unless otherwise noted on the drawings.
33 E. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5,
34 unless otherwise noted on the drawings.

- 1 F. Control transformer fuses: Class CC (time delay).
- 2 G. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.
- 3 **2.3 SPARE FUSE CABINET**
- 4 A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door
- 5 and key-coded cam lock and pull.
- 6 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
- 7 2. Finish: Gray, baked enamel.
- 8 3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
- 9 4. Fuse Pullers: For each size of fuse.

10 **PART 3 - EXECUTION**

11 **3.1 INSTALLATION**

- 12 A. Install fuses where indicated on the drawings and specifications.
- 13 B. Install fuses in accordance with manufacturer's instruction.
- 14 C. Install fuses in packaged equipment as required by equipment manufacturer.
- 15 D. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- 16 E. Install spare fuse cabinet next to the main library distribution panel.

17 **END OF SECTION**

1 **SECTION 26 28 16**
2 **DISCONNECT SWITCHES**

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Fusible switches
- 6 B. Non-fusible switches
- 7 C. Molded case circuit switches
- 8 D. Molded case switches
- 9 E. Motor disconnect switch
- 10 F. Mechanically interlocked disconnect
- 11 G. Enclosures

12 **1.2 RELATED SECTIONS AND WORK**

- 13 A. Refer to the Disconnect and Starter Schedule for rating and configuration.

14 **1.3 REFERENCES**

- 15 A. NEMA KS 1 - Enclosed Switches

16 **1.4 SUBMITTALS**

- 17 A. Submit product data under provisions of Section 26 05 00.
- 18 B. Product Data: For each type of enclosed switch, circuit breaker, accessory and component indicated, include
19 dimensions, weights, and manufacturer's technical data on features, performance, and ratings.
- 20 C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings,
21 short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings,
22 and factory settings of individual overcurrent protective devices and auxiliary components.

23 **1.5 COORDINATION**

- 24 A. Coordinate layout and installation of switches, circuit breakers, and components with other construction,
25 including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and
26 required clearances for equipment access doors and panels.

27 **PART 2 - PRODUCTS**

28 **2.1 FUSIBLE AND NON-FUSIBLE SWITCHES**

- 29 A. **[FDS-#]:** Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter
30 enclosed knife switch with externally operable handle interlocked to prevent opening front cover with
31 switch in ON position. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated
32 otherwise on the drawings.
- 33 B. **[DS-#]:** Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load
34 interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front
35 cover with switch in ON position. Handle lockable in OFF position.
- 36 C. Enclosures: Type as indicated on the disconnect schedule.
- 37 D. Accessories: As indicated on the disconnect schedule.

1 **2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES**

- 2 A. **[CB-#]:** Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
- 3 1. Thermal Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and
4 instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-
5 breaker frame sizes 250 A and larger.
- 6 2. Adjustable Instantaneous Trip Circuit Breakers: Magnetic trip element with front-mounted, field-
7 adjustable trip settings.
- 8 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following
9 field-adjustable settings:
- 10 a. Instantaneous trip.
- 11 b. Long- and short-time pickup levels.
- 12 c. Long- and short-time adjustments.
- 13 d. Ground-fault pickup level, time delay, and I²t responses.
- 14 4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than
15 NEMA FU 1, RK-5.
- 16 B. **[CB-#]:** Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and
17 short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- 18 C. Accessories: As indicated on the disconnect schedule.

19 **2.3 MOTOR DISCONNECT SWITCH**

- 20 A. **[DS-#]:** Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with
21 externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle
22 lockable in OFF position.
- 23 B. Enclosures: Type as indicated on the Disconnect Schedule.
- 24 C. Ground lug connection provided in enclosure.
- 25 D. Accessories: As indicated on the Disconnect Schedule.
- 26 E. Listed UL 508 suitable for motor control.

27 **2.4 MECHANICALLY INTERLOCKED DISCONNECT**

- 28 A. **[DSS-#]:** Switch and Plug Assemblies: Rated for making and breaking loads, enclosed switch with externally
29 operable interlock to prevent disconnecting receptacle with switch in ON position or inserting receptacle in
30 ON position. Padlock lockable provision to meet OSHA lockout/tagout regulations.
- 31 B. Enclosures: Type as indicated on the Disconnect Schedule.
- 32 C. Ground lug connection provided in enclosure.
- 33 D. Accessories: Matching male pin and sleeve plug, two auxiliary/pilot contacts. As indicated on the Disconnect
34 Schedule.
- 35 E. Listed UL 2682 suitable for motor disconnect.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

- 3 A. Install disconnect switches where indicated on the drawings.
- 4 B. Install fuses in fusible disconnect switches.
- 5 C. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

6 **3.2 ADJUSTING**

- 7 A. Set field-adjustable circuit breaker trip ranges.

8 **END OF SECTION**

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**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. Eaton Corporation
- C. G.E.
- D. ASCO

[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.

[LC-#]: LIGHTING CONTACTORS

- A. Contactors: NEMA ICS 2 and UL 508; electrically held, 2-wire control.

- 1 B. Coil Operating Voltage: 120 volts, 60 Hertz.
- 2 C. Contacts: 10 pole.
- 3 D. Enclosure: ANSI/NEMA ICS 6; Type 1.
- 4 E. Provide solderless pressure wire terminals.

5 **PART 3 - EXECUTION**

6 **3.1 INSTALLATION**

- 7 A. Install in accordance with manufacturer's instructions.
- 8 B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and
9 nonpower-limited conductors according to conductor manufacturer's written instructions.
- 10 C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise
11 indicated.
- 12 D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction boxes: and
13 equipment enclosures.
- 14 E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values.
15 If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

16 **END OF SECTION**

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 distribution panels and electronic equipment.

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. Fuses: Furnish to the Owner 3 spare fuses of each type and rating installed.

1 **1.6 TESTING, WARRANTY AND LIFE EXPECTANCY**

2 A. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating
3 of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated
4 with the manufacturer.

5 1. Single pulse surge current capacity: Single pulse surge current tested in a mode at rated surge
6 currents.

7 2. Single pulse surge current capacity test: An initial UL 1449 defined 1.2 x 50µs, 6000V open circuit
8 voltage waveform and an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied
9 to benchmark the unit's suppression voltage (VPR).

10 3. A single 8 x 20µs waveform pulse of maximum rated surge current per mode shall then be
11 applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.
12 Survival is achieved if the suppression voltage measured from the two UL1449 surges does not
13 vary by more than 10%.

14 B. Minimum Repetitive Surge Current Capacity:

15 1. Service entrance suppressor units should be tested repetitively at an independent lab to verify
16 repetitive capacity.

17 2. Minimum Repetitive Surge Current Capacity Test:

18 a. An initial UL 1449 surge defined as 1.2 x 50µs, 6000V open circuit voltage waveform and
19 an 8 x 20µs, 500A and 3kA short circuit current waveform shall be applied to benchmark
20 the unit's suppression voltage.

21 b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges, defined as a 1.2 x
22 50µs 10kV or 20kV open circuit voltage waveform and an 8 x 20µs 10,000A short circuit
23 current waveform, shall then be applied at one-minute intervals.

24 c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.

25 3. Survival is achieved if the suppression voltage (VPR) does not vary by more than 10%.

26 4. Proof of such testing shall be the test log generated by the surge generator.

27 C. Provide UL 1449 classification white sheet pages indicating the VPR (voltage protection rating) for each SPD
28 unit submitted for this product using the 6kV/3kA combination wave surge.

29 D. Warranty: Ten (10) years. Includes workmanship, installation and programming.

30 **PART 2 - PRODUCTS**

31 **2.1 DESCRIPTION**

32 A. General: The unit shall provide transient voltage suppression, surge current diversion and high-frequency
33 noise attenuation, when connected in parallel to the facilities distribution system. The unit MCOV shall not
34 be less than 115% of the nominal system voltage. Operating frequency shall be for a 60 Hz system. The unit
35 shall provide protection in all normal modes for "wye" and "delta" systems. The short circuit current rating
36 shall be the larger of the listed value on the drawings or as required by the equipment protected.

- 1 **2.2 RATINGS**
- 2 A. **[SPD-#]: Secondary Distribution Suppressors:**
- 3 1. For 120/208-volt, 3 phase, 4 wire, type 2, category B3/C1 unit.
- 4 a. Surge current capacity: 100,000/200,000 amps per protection mode/phase
- 5 b. Nominal Discharge Current (I_N): 20 kA.
- 6 c. Mounting: Refer to the drawings.
- 7 d. Voltage Protection Rating: Refer to requirements below.
- 8 e. Components: Minimum component size of 20mm metal oxide varistors (MOV).
- 9 2. Approved Manufacturers:
- 10 a. Square D Surgelogic EMA Series
- 11 b. Siemens/APT TPS3 Series
- 12 c. Cutler Hammer SPD Series
- 13 d. Current Technology Current Guard Plus
- 14 e. Emerson Network Power 510 Series
- 15 f. LEA International CFS Series
- 16 B. Voltage Protection Rating:
- 17 1. Protection modes and UL 1449 voltage protection rating for surge suppression units per each
- 18 mode (L-N, L-L, L-G, and N-G as appropriate).
- 19 a. 120/208 Volt, 3 phase, 4 wire. 700 Volt L-N, N-G, 800 Volt L-G and 1200 Volt L-L
- 20 C. Critical Load Protection – Fixed Equipment:
- 21 1. For 120-volt, 1 phase, 3 wire, type 3, category A3 unit.
- 22 a. Surge current capacity (I_N): 15,000/30,000 amps per protection mode/phase
- 23 b. Mounting: External, NEMA 12 enclosure
- 24 c. Components: Nonmodular units composed of 20mm Metal Oxide Varistors (MOV).
25 Series inductors, SAD, or selenium cells may be used in addition to MOVs.
- 26 d. Protection modes and UL 1449 clamping voltage: 475 Volt L-N, L-G, and N-G.
- 27 D. EMI/RFI Noise Rejection or Filtering:
- 28 1. Each unit shall include a UL1283 first order, high-frequency filter for noise filtering between 10
- 29 KHz and 100 MHz.
- 30 E. Indication:
- 31 1. Each unit shall include solid-state indicators with externally mounted LED visual status indicators
- 32 that indicate on-line status of each protection mode of the unit.
- 33 2. Provide each secondary distribution and critical load type unit(s) with a transient counter.

**SECTION 26 51 00
LIGHTING**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Exterior luminaires and accessories

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 LZ2

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.

1 **1.4 EXTRA STOCK**

- 2 A. Provide extra stock under provisions of Section 26 05 00.
- 3 B. LED Light Engines or Modules: Five (5) percent of quantity installed, minimum of one (1) of each size and type.
- 4 C. Other Lamps: Five (5) percent of quantity installed. Minimum of two (2) of each size and type, and maximum
5 of one (1) case (20 lamps).
- 6 D. Lenses: Three (3) percent of quantity installed, minimum of one (1) of each size and type.

7 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 8 A. Deliver products to site. Store and protect under provisions of Section 26 05 00.
- 9 B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove
10 protective films until construction cleanup within each area is complete.
- 11 C. Handle site lighting poles carefully to prevent breakage and damage to finish.

12 **1.6 WARRANTY**

- 13 A. Light emitting diode (LED) light engines and drivers shall have a ten-year warranty from date of Substantial
14 Completion.

15 **PART 2 - PRODUCTS**

16 **2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL**

- 17 A. Lensed Troffers: Provide hinged frames with latches and 0.125-inch thick virgin acrylic lenses. Prismatic lenses
18 shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.
- 19 B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit
20 proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install
21 listed enclosures around luminaires that maintain the system rating.
- 22 C. Suspended Luminaires: Coordinate power feed and suspension canopies with ceiling type and architectural
23 RCP for proper fit and location. Ensure finished installations are plumb and level at elevations specified.
- 24 D. Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting type as
25 indicated on the drawings.
- 26 E. Self-Powered Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting
27 type as indicated on the drawings. One-piece, self-contained unit with sealed, maintenance-free nickel
28 cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery
29 when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay
30 disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- 31 F. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel
32 cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery
33 when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay
34 disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- 35 G. Painted reflector surfaces shall have a minimum reflectance of 90%.
- 36 H. All painted components shall be painted after fabrication.

1 **2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL**

- 2 A. Listed for wet or damp location as scheduled. Fountain and pool luminaires shall be listed for submersible
3 location to meet depth specified.
- 4 B. Provide low temperature ballasts or LED drivers, with reliable starting to -20°F.
- 5 C. In-grade luminaires shall have lamp/optic separation to prevent surface temperature from exceeding 115°F.
6 Compartment separation of wire entry and control gear/lamp chamber.

7 **2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS**

- 8 A. Light emitting diodes used in interior applications shall have a minimum color rendering index (CRI) of 80.
9 Light emitting diodes used in exterior applications shall have a minimum color rendering index (CRI) of 70.
10 Color temperature of the luminaires shall be as noted on the luminaire schedule.
- 11 B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.
- 12 C. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip
13 array.
- 14 D. LED Driver:
- 15 1. Solid state driver with integral heat sink. Driver shall have overheat, short-circuit and overload
16 protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Surge
17 suppression device for all exterior luminaires.
- 18 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire
19 type.
- 20 3. Driver shall have a minimum of 50,000 hours rated life.

21 **PART 3 - EXECUTION**

22 **3.1 INSTALLATION**

- 23 A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as
24 bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. If ceiling framing
25 is not listed for luminaire size or weight, support luminaires independent of ceiling grid with a minimum of
26 two (2) #12 gauge wires located on diagonal corners.
- 27 B. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames
28 and swing gate supports. Support luminaires independent of ceiling with a minimum of two (2) #12 gauge
29 wires located on diagonal corners.
- 30 C. Support surface-mounted luminaires directly from building structure. Install luminaires larger than eight
31 square feet (8 ft²) or weighing more than 30 pounds independent of ceiling framing.
- 32 D. Support suspended or pendant mounted luminaires independent of ceiling grid with a minimum of two #12
33 gauge wires. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each
34 suspension point.
- 35 E. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting
36 levels.
- 37 F. Parabolic louvers and other optical accessories shall remain in protective wraps or films until construction in
38 area is complete and area has been cleaned.

1 G. Industrial Pendant Luminaires: Use hangers rated 500 pounds minimum or provide safety chain between
2 ballast and structure. Provide safety chain between reflector and ballast.

3 **3.2 RELAMPING**

4 A. Replace failed light sources and drivers at completion of work.

5 **3.3 ADJUSTING AND CLEANING**

6 A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris
7 from installed luminaires.

8 B. Touch up luminaire finish at completion of work.

9 **3.4 LUMINAIRE SCHEDULE**

10 A. As shown on the drawings.

11 **END OF SECTION**

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SECTION 26 52 00
EMERGENCY LIGHTING EQUIPMENT

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Emergency exit signs with self-test capability
6 B. Emergency inverters for LED

7 **1.2 REFERENCES**

- 8 A. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)
9 B. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures
10 C. UL 924 – Emergency Lighting and Power Equipment

11 **1.3 SUBMITTALS**

- 12 A. Submit shop drawings under provisions of Section 26 05 00.
13 B. Provide product data on emergency lighting units, exit signs, emergency inverters, and emergency fluorescent
14 lamp power supply units.

15 **1.4 REGULATORY REQUIREMENTS**

- 16 A. Conform to NFPA 101 for installation requirements.

17 **PART 2 - PRODUCTS**

18 **2.1 SELF-CONTAINED EMERGENCY POWER EXIT SIGNS**

- 19 A. Type: Exit signs with integral battery-operated emergency power supply, including power failure relay, test
20 switch, AC ON pilot light, battery, and fully-automatic two-rate charger.
21 B. Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for 10 years under
22 normal conditions.
23 C. Directional Indicators: The directional indicator for exit signage shall be of a chevron type meeting all
24 requirements of NFPA 101.
25 D. Unit shall be self-diagnostic with continuous monitoring of charger performance and battery voltage. Any
26 malfunction of battery, charger, transfer circuit or emergency lamps shall be detected and visually indicated.
27 E. Unit shall be programmed to exercise the battery and test emergency operation by performing a five-minute
28 discharge/diagnostic cycle every 6 months. A manual test switch shall allow a five minute
29 discharge/diagnostic test at any time.

30 **2.2 ACCEPTABLE MANUFACTURERS - EMERGENCY INVERTERS**

- 31 A. Philips/Bodine.
32 B. Dual-Lite.
33 C. Iota.

- 1 **2.3 EMERGENCY INVERTER – LED LAMPS UP TO 20 WATTS**
- 2 A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for
3 factory or field installation in indoor and damp locations.
- 4 B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90
5 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life
6 expectancy.
- 7 C. Features: Integral battery charger with LED charging indicator light, test switch, electronic circuitry for use
8 with ballasts, and LED drivers. Output of inverter shall be sinusoidal with solid-state low voltage disconnect
9 circuit.
- 10 D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from
11 below ceiling through luminaire opening.
- 12 E. Charging indicator LED and test switch to be mounted in remote test/monitor plate provided with inverter.
- 13 F. Inverter capable of operating a switched, dimmed or unswitched luminaire up to 20 watts with full lumen
14 output.
- 15 G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

16 **2.4 EMERGENCY LED DRIVER**

- 17 A. Unit: Self-contained, with automatic transfer to battery supply on loss of normal power, UL 924 listed for
18 factory or field installation in indoor and damp locations.
- 19 B. Battery: Sealed, high temperature, maintenance free, nickel cadmium battery with capacity to provide 90
20 minutes of emergency operation, with 24-hour recharge time, seven (7) year minimum battery life
21 expectancy.
- 22 C. Features: Integral battery charger with LED charging indicator light, test switch, and electronic circuitry for
23 use with LED drivers.
- 24 D. Inverter to be mounted remote and adjacent to luminaire shown on drawings. Inverter to be accessible from
25 below ceiling through luminaire opening.
- 26 E. Charging indicator LED and test switch to be mounted in remote test/monitor plate.
- 27 F. Inverter capable of operating a switched, dimmed, or unswitched luminaire up to 7 watts at a rated current
28 of 270mA.
- 29 G. Warranty: Emergency inverter shall have a full five (5) year, non-prorated warranty.

30 **PART 3 - EXECUTION**

31 **3.1 INSTALLATION**

- 32 A. Install units plumb and level.
- 33 B. Aim directional lampheads as directed.
- 34 C. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to substantial
35 completion. Provide typewritten periodic test log form to Owner's representative. Explain and instruct
36 Owner's representative of requirements for testing and maintenance.

37 **END OF SECTION**

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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 07 84 00.

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 documents 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.

- 1 B. Definitions:
- 2 1. "Electrical Contractor" as referred to herein refer to the Contractors listed in Division 26 of this
3 Specification.
- 4 2. "Electrical Contractor" shall also refer to the Contractor listed in Division 27 of this specification
5 when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the
6 EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
- 7 3. "Communications Contractor" as referred to herein refer to the Contractors listed in Division 27 of
8 this Specification.
- 9 4. Low Voltage Communications Wiring: The wiring (less than 120VAC) associated with the
10 Communications Systems, used for analog and/or digital signals between equipment.
- 11 5. Telecommunications Rough-in: Relates specifically to the backboxes, necessary plaster rings and
12 other miscellaneous hardware required for the installation and mounting of the
13 telecommunications information outlet. The cabling distribution will be accomplished via
14 underfloor and overhead pathways, will all cables routed to the Telecommunications Equipment
15 Room, unless noted otherwise on drawings. Rough-in shall include conduit from the information
16 outlet backbox to the nearest underfloor pathway, cable tray, or to the nearest wall above the
17 ceiling, as applicable.
- 18 C. General:
- 19 1. The purpose of these Specifications is to outline typical Electrical and Communications
20 Contractor's work responsibilities as related to Communications Systems including
21 Telecommunications rough-in, conduit, cable tray, power wiring and Low Voltage
22 Communications Wiring. The prime contractor is responsible for all divisions of work.
- 23 2. The exact wiring requirements for much of the equipment cannot be determined until the
24 systems have been purchased and submittals are approved. Therefore, only known wiring,
25 conduits, raceways, and electrical power as related to such items, is shown on the
26 Communications Drawings. Other wiring, conduits, raceways, junction boxes, and electrical
27 power not shown on the Communications Drawings but required for the successful operation of
28 the systems shall be the responsibility of the Communications Contractor and included in the
29 Contractor's bid.
- 30 3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power
31 connections in support of Communications systems, the final installation shall not begin until a
32 coordination meeting between the Electrical Contractor and the Communications Contractor has
33 convened to determine the exact location and requirements of the installation.
- 34 4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage
35 Communications Wiring, the installation shall not begin until the Communications Contractor has
36 completed a coordination review of the cable tray shop drawing.
- 37 5. This Contractor shall establish Electrical and Communications utility elevations prior to fabrication
38 and installation. The Communications Contractor shall cooperate with the Electrical Contractor
39 and the determined elevations in accordance with the guidelines below. This Contractor shall
40 coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
- 41 a. Lighting Fixtures
42 b. Gravity Flow Piping, including Steam and Condensate
43 c. Sheet Metal
44 d. Electrical Busduct
45 e. Cable Trays, including 12" access space
46 f. Sprinkler Piping and other Piping

- 1 g. Conduit and Wireway
- 2 h. Open Cabling

- 3 D. Electrical Contractor's Responsibility:
- 4 1. Assumes all responsibility for all required conduit and power connections when shown on the
- 5 "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
- 6 2. Assumes all responsibility for providing and installing cable tray.
- 7 3. Responsible for Communications Systems grounding and bonding.
- 8 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
- 9 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
- 10 determine a viable layout.

- 11 E. Communications Contractor's Responsibility:
- 12 1. Assumes all responsibility for the Low Voltage Communications Wiring of all systems, including
- 13 cable support where open cable is specified.
- 14 2. Assumes all responsibility for all required backboxes, conduit and power connections not
- 15 specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of
- 16 Scope Responsibility."
- 17 3. Assumes all responsibility for providing and installing all ladder rack and other cable management
- 18 hardware (as defined in here-in).
- 19 4. Responsible for providing the Electrical Contractor with the required grounding lugs or other
- 20 hardware for each piece of Communications equipment which is required to be bonded to the
- 21 Communications ground system.
- 22 5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
- 23 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
- 24 determine a viable layout.

- 25 1.5 COORDINATION DRAWINGS

- 26 A. Definitions:
- 27 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the
- 28 sizes and locations, including elevations, of system components and required access areas to
- 29 ensure that no two objects will occupy the same space.
- 30 a. Mechanical trades shall include, but are not limited to, mechanical equipment,
- 31 ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic
- 32 piping, steam and steam condensate piping, and any item that may impact coordination
- 33 with other disciplines.
- 34 b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5"
- 35 and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway,
- 36 lighting, ceiling-mounted devices, and any item that may impact coordination with other
- 37 disciplines.
- 38 c. Technology trades shall include, but are not limited to, technology equipment, racks,
- 39 conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway,
- 40 ceiling-mounted devices, and any item that may impact coordination with other
- 41 disciplines.

-
- 1 d. Maintenance clearances and code-required dedicated space shall be included.
- 2 e. The coordination drawings shall include all underground, underfloor, in-floor, in chase,
3 and vertical trade items.
- 4 2. The contractors shall use the coordination process to identify the proper sequence of installation
5 of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated
6 end result, and to provide adequate access for service and maintenance.
- 7 B. Participation:
- 8 1. The contractors and subcontractors responsible for work defined above shall participate in the
9 coordination drawing process.
- 10 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a
11 complete set of composite electronic CAD coordination drawings that include all applicable
12 trades, and for coordinating the activities related to this process. The Coordinating Contractor for
13 this project shall be the Mechanical Contractor.
- 14 a. The Coordinating Contractor shall utilize personnel familiar with requirements of this
15 project and skilled as draftspersons/CAD operators, competent to prepare the required
16 coordination drawings.
- 17 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by
18 other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use
19 if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG
20 will not consider blatant reproductions of original file copies an acceptable alternative for
21 coordination drawings.
- 22 C. Drawing Requirements:
- 23 1. The file format and file naming convention shall be coordinated with and agreed to by all
24 contractors participating in the coordination process and the Owner.
- 25 a. Scale of drawings:
- 26 1) General plans: 1/4 Inch = 1'-0" (minimum).
- 27 2) Mechanical, electrical, communication rooms, and including the surrounding
28 areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
- 29 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
- 30 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch =
31 1'-0" (minimum).
- 32 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
- 33 2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout
34 drawings shall be modified to accommodate other components as the coordination process
35 progresses.
- 36 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and
37 shafts.
- 38 4. The minimum quantity of drawings will be established at the first coordination meeting and sent
39 to the A/E for review. Additional drawings may be required if other areas of congestion are
40 discovered during the coordination process.

- 1 D. General:
- 2 1. Coordination drawing files shall be made available to the A/E and Owner’s Representative. The
3 A/E will only review identified conflicts and give an opinion, but will not perform as a coordinator.
- 4 2. A plotted set of coordination drawings shall be available at the project site.
- 5 3. Coordination drawings are not shop drawings and shall not be submitted as such.
- 6 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance
7 for each utility. Each contractor is expected to have included in his/her bid sufficient fittings,
8 material, and labor to allow for adjustments in routing of utilities made necessary by the
9 coordination process and to provide a complete and functional system.
- 10 5. The contractors will not be allowed additional costs or time extensions due to participation in the
11 coordination process.
- 12 6. The contractors will not be allowed additional costs or time extensions for additional fittings, re-
13 routings or changes of duct size, that are essentially equivalent sizes to those shown on the
14 drawings and determined necessary through the coordination process.
- 15 7. The A/E reserves the right to determine space priority of equipment in the event of spatial
16 conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by
17 the trades.
- 18 8. Changes to the contract documents that are necessary for systems installation and coordination
19 shall be brought to the attention of the A/E.
- 20 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated
21 on the drawings.
- 22 a. Access to mechanical, electrical, technology, and other items located above the ceiling
23 shall be through accessible lay-in ceiling tile areas.
- 24 b. Potential layout changes shall be made to avoid additional access panels.
- 25 c. Additional access panels shall not be allowed without written approval from the A/E at
26 the coordination drawing stage.
- 27 d. Providing additional access panels shall be considered after other alternatives are
28 reviewed and discarded by the A/E and the Owner's Representative.
- 29 e. When additional access panels are required, they shall be provided without additional
30 cost to the Owner.
- 31 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors
32 prior to installing any of the components.
- 33 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of
34 the contractor or subcontractor who did not properly identify their work requirements, or
35 installed their work without proper coordination.
- 36 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1 **1.6 QUALITY ASSURANCE**

2 A. Telecommunications Structured Cabling System Standards:

3 1. All work and equipment shall conform to the most current ratified version of the following
4 published standards unless otherwise indicated that draft standards are to be followed:

5 a. TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and
6 Spaces.

7 b. TIA/EIA 606 – Administration Standards for the Telecommunications Infrastructure of
8 Commercial Buildings.

9 c. TIA/EIA 607 – Commercial Building Grounding and Bonding Requirements for
10 Telecommunications.

11 d. ANSI/NECA 568 – Standard for Installing Commercial Building Telecommunications
12 Cabling.

13 e. TIA/EIA 568-B – Commercial Building Telecommunications Cabling Standard

14 1) B.1 – Part 1: General Requirements

15 2) B.1-1 – Addendum 1: Minimum 4-Pair UTP and 4-Pair ScTP Patch Cable Bend
16 Radius.

17 3) B.2 – Part 2: Balanced Twisted Pair Cabling Components.

18 4) B.2-1-2002– Addendum 1: Transmission Performance Specifications for 4-Pair
19 100 Ohm Category 6 Cabling.

20 f. UL 444 – Standard for Safety for Communications Cable.

21 g. NFPA 70 (NEC) – National Electrical Code.

22 B. Refer to individual sections for additional Quality Assurance requirements.

23 C. Qualifications:

24 1. Only products of reputable manufacturers as determined by the Engineer will be acceptable.

25 2. The installing Contractor shall be certified by the manufacturer of the structured cabling system.
26 Certification of Contractor shall have been in place for a minimum of one (1) year prior to bidding
27 this project. Documentation of certification is required at the time of bid. Shop drawings will not
28 be approved until proof of certification is submitted. Refer to the end of this specification section
29 for certification documentation requirements.

30 3. Each Contractor and their subcontractors shall employ only workers who are skilled in their
31 respective trades and fully trained. All workers involved in the termination of cabling shall be
32 individually certified by the manufacturer.

33 4. The Contractor shall be experienced in all aspects of this work and shall be required to
34 demonstrate direct experience on recent systems of similar type and size.

35 5. The Contractor shall own and maintain tools and equipment necessary for successful installation
36 and testing of optical and copper structured cabling systems and have personnel adequately
37 trained in the use of such tools and equipment.

- 1 6. The Contractor shall have certified BICSI installation technicians on staff to perform the following
2 tasks on the project:
- 3 a. Act as the field superintendent or job foreman with the responsibility of monitoring the
4 daily work of each technician.
- 5 b. Oversee all testing and termination of cabling.
- 6 7. A resume of qualification shall be submitted with the Contractor's bid indicating the following:
- 7 a. Documentation of certification of This Contractor by the proposed structured cabling
8 system manufacturer as required at the end of this specification section.
- 9 b. A list of recently completed projects of similar type and size with contact names and
10 telephone numbers for each.
- 11 c. A list of test equipment proposed for use in verifying the installed integrity of copper
12 and fiber optic systems on the project.
- 13 d. A technical resume of experience for the Contractor's project manager and on-site
14 installation supervisor assigned to this project.
- 15 e. Resume and certification of the BICSI/CNIT installation technician for the project.
- 16 D. Compliance with Codes, Laws, Ordinances:
- 17 1. This Contractor shall conform to all requirements of the City of Madison, Wisconsin Codes, Laws,
18 Ordinances and other regulations having jurisdiction over this installation.
- 19 2. In the event there are no local codes having jurisdiction over this job, the current issue of the
20 National Electrical Code shall be followed.
- 21 3. If there is a discrepancy between the codes and regulations having jurisdiction over this
22 installation, and these specifications, the codes and regulations shall determine the method or
23 equipment used.
- 24 4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which
25 are not in accordance with the applicable codes or regulations, he shall inform the
26 Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this
27 procedure, he shall submit with the proposal, a separate price required to make the system
28 shown on the drawings comply with the codes and regulations.
- 29 5. All changes to the system made after the letting of the contract, in order to comply with the
30 applicable codes or the requirements of the Inspector, shall be made by the Contractor without
31 cost to the Owner.
- 32 E. Permits, Fees, Taxes, Inspections:
- 33 1. Refer to Division 0 for all requirements. Procure all applicable permits and licenses.
- 34 2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political
35 Subdivision wherein the work is done, or as required by any duly constituted public authority.
- 36 3. This Contractor is responsible for all applicable permits and fees related to this project. This
37 Contractor is required to notify the City of Madison Project Manager as to what permits are
38 required. The City of Madison will pay all applicable charges for such permits that may be
39 required, prior to the permit(s) being issued.

- 1 4. All equipment and materials shall be as approved or listed by the following (unless approval or
2 listing is not applicable to an item by all acceptable manufacturers):
- 3 a. Factory Mutual
4 b. Underwriters' Laboratories, Inc.
- 5 F. Examination of Drawings:
- 6 1. The drawings for the Communications Systems work are diagrammatic, intended to convey the
7 scope of the work and to indicate the general arrangements and locations of equipment etc., and
8 the approximate sizes of equipment.
- 9 2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as
10 to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for
11 determining this layout. Where a specific route is required, such route will be indicated on the
12 drawings.
- 13 3. Where job conditions require reasonable changes in indicated arrangements and locations, such
14 changes shall be made by the Contractor at no additional cost to the Owner.
- 15 4. If an item is either shown on the drawings, called for in the specifications, or required for proper
16 operation of the system, it shall be considered sufficient for including the same in this contract.
- 17 5. The determination of quantities of material and equipment required shall be made by the
18 Contractor from the drawings. Schedules on the drawings and in the specifications, are
19 completed as an aid to the Contractor but where discrepancies arise, the greater number shall
20 govern.
- 21 6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it
22 shall be taken to mean, to furnish, install and terminate completely ready for operation, the items
23 mentioned.
- 24 G. Electronic Media/Files:
- 25 1. Construction drawings for this project have been prepared utilizing Revit MEP.
- 26 2. Contractors and Subcontractors may request electronic media files of the contract drawings
27 and/or copies of the specifications. Specifications will be provided in PDF format.
- 28 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic
29 File Transmittal" form provided by IMEG.
- 30 4. If the information requested includes floor plans prepared by others, the Contractor will be
31 responsible for obtaining approval from the appropriate Design Professional for use of that part of
32 the document.
- 33 5. The electronic contract documents can be used for preparation of shop drawings and as-built
34 drawings only. The information may not be used in whole or in part for any other project.
- 35 6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork
36 layout drawings or coordination drawings.
- 37 7. The use of these CAD documents by the Contractor does not relieve them from their responsibility
38 for coordination of work with other trades and verification of space available for the installation.
- 39 8. The information is provided to expedite the project and assist the Contractor with no guarantee
40 by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no
41 responsibility or liability for the Contractor's use of these documents.

- 1 H. Field Measurements:
- 2 1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site
3 and be responsible for their accuracy.
- 4 2. Field conditions that will result in telecommunications drops that exceed the length limitations
5 identified in the contract documents shall be brought to the attention of the Engineer prior to
6 installation. The cost of reworking cabling that is too long, that was not brought to the written
7 attention of the Engineer will be borne entirely by the Contractor.
- 8 3. This Contractor shall provide the Engineer with written documentation of any cabling drops that
9 will not be able to use the cable tray (where cable tray is available) due to the resulting cabling
10 lengths. This documentation shall be submitted prior to installation and installation shall not
11 commence until approved by the Engineer.

12 **1.7 SUBMITTALS**

- 13 A. Submittals shall be required for the following items, and for additional items where required elsewhere in
14 the specifications or on the drawings.

- 15 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 13 00	Backbone Cabling Requirements
27 15 00	Horizontal Cabling Requirements
27 17 10	Testing
27 21 33	Wireless Access Points (WAS)
27 41 00	Professional Audio/Video System
27 41 23	Audio Visual Accessories

- 16 B. In addition to the provisions of Division 1, the following is required:

- 17 1. Submittals shall include all layout drawings; manufacturers' standard drawings; schedules;
18 descriptive literature, catalogs and brochures; performance and test data; wiring diagrams; and all
19 other drawings and descriptive data of materials of construction as may be required to show that
20 the materials, equipment or systems and the location thereof conform to the requirements of the
21 contract documents.
- 22 2. The Contractor shall submit an electronic copy of each shop drawing for review by the
23 Architect/Engineer BEFORE releasing any equipment for manufacture or shipment.
- 24 3. Shop drawings which are larger than 11" x 17" or are plan size layout drawings such as wiring
25 diagrams and cable tray drawings, shall be submitted on reproducible media. Submit one
26 reproducible and one print of each drawing or plan. All Contractor approval stamps shall be made
27 on the reproducible. The Architect/Engineer will return the reproducible copy of the shop
28 drawings, complete with comments. This Contractor shall copy and distribute these reviewed
29 shop drawings as required. All costs for copying and distribution of reproducible shop drawings
30 shall be included by This Contractor in their bid.

- 1 4. The Contractor shall thoroughly review and approve all shop drawings before submitting them to
2 the Architect/Engineer. CONTRACTOR'S APPROVAL STAMP IS REQUIRED ON ALL SUBMITTALS.
3 APPROVAL WILL INDICATE THE CONTRACTOR'S REVIEW of all material and a COMPLETE
4 UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. Contractor shall clearly mark all
5 deviations from the contract documents on all submittals. IF DEVIATIONS ARE NOT MARKED BY
6 THE CONTRACTOR, THEN THE ITEM SHALL BE REQUIRED TO MEET ALL DRAWING AND
7 SPECIFICATION REQUIREMENTS.
- 8 5. The Contractor shall provide RCDD stamp on the submittal.
- 9 6. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings
10 or in the specifications.
- 11 7. The Contractor shall clearly indicate the size, finish, material, etc.
- 12 8. All submittals shall be assembled in sets by system.
- 13 9. Each set shall be bound in a manufacturer's folder or inside of a manila file folder.
- 14 10. Each set shall contain an index of the items enclosed with a general topic description on the cover.
- 15 11. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly
16 indicate exactly which item and which data is relevant to the work.
- 17 12. Failure to comply with the above shall be reason to resubmit all shop drawing submittals.
- 18 13. The Engineer's responsibility shall be to review one set of shop drawing submittals for each
19 product. If the first submittal is incomplete or does not comply with the drawings and/or
20 specifications, the Contractor shall be responsible to bear the cost for the Engineer to recheck and
21 handle the additional shop drawing submittals.
- 22 14. Provide documentation of all warranties required by the contract documents.
- 23 15. Submit copy of the Contractor certification form contained at the end of specification section.
- 24 C. Provide Schedule of Values for Technology Work:
- 25 1. Application forms: Use AIA Document Continuation Sheets G703 (or similar) as the form for
26 application.
- 27 2. Provide line items on the Schedule of Values including:
- 28 a. Structured Cabling
- 29 b. Security (Access control and video surveillance) Systems
- 30 c. Audio/Video Systems
- 31 3. Change orders shall have schedule of values broken out as listed above submitted with each
32 change order.
- 33 4. Coordinate with the Project Engineer the items included in the Schedule of Values. The intent is to
34 not create schedules in addition to those the Technology Contractor normally submits to the
35 General Contractor for payment.

1 **1.8 EQUIPMENT SUPPLIERS' INSPECTION**

2 A. The following equipment shall not be placed in operation until a representative of the manufacturer has
3 inspected the installation and certified that the equipment is properly installed and that the equipment is
4 ready for operation:

5 1. Firestopping, including mechanical firestop systems.

6 **1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

7 A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

8 B. Store materials on the site so as to prevent damage.

9 C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

10 **1.10 WARRANTY**

11 A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual
12 specifications sections within Division 27 may require additional warranty requirements for specific
13 equipment or systems.

14 B. Provide a structured cabling System Assurance Warranty as described herein.

15 C. The warranty period for the entire installation described in this Division of the specifications shall
16 commence on the date of substantial completion unless a whole or partial system or any separate piece of
17 equipment or component is put into use for the benefit of any party other than the installing contractor
18 with prior written authorization. In this instance, the warranty period shall commence on the date when
19 such whole system, partial system or separate piece of equipment or component is placed in operation and
20 accepted in writing by the Owner or their representative.

21 D. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or
22 equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear
23 the cost of correcting all damage resulting from such defects or nonconformance with contract documents
24 exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as
25 determined by the Architect/Engineer.

26 **1.11 INSURANCE**

27 A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

28 **1.12 MATERIAL**

29 A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job
30 design and establishes the equipment quality required to be used in this contract.

31 B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall
32 ensure that all items submitted by these other manufacturers meets all requirements of the drawings and
33 specifications and fits in the allocated space. The Engineer shall make the final determination of whether a
34 product is equivalent.

35 C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the
36 services and duties imposed by the design and is of a quality equal to or better than the material, article or
37 equipment identified by the drawings and specifications may be used if approval is secured **in writing** from
38 the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full
39 responsibility for the unnamed manufacturer's equipment adequately meeting the intent of design. The
40 Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all
41 costs incurred by other trades on the project as a result of changes necessary to accommodate the offered
42 material, equipment or installation method.

- 1 D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed
2 manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate
3 materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary
4 alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of
5 using the offered material, article or equipment necessitating extra expense on This Contractor or on the
6 part of other Contractors whose work is affected.

7 **PART 2 - PRODUCTS**

8 **2.1 REFER TO INDIVIDUAL SECTIONS**

9 **PART 3 - EXECUTION**

10 **3.1 JOBSITE SAFETY**

- 11 A. Neither the professional activities of the Engineer, nor the presence of the Engineer or his or her employees
12 and subconsultants at a construction site, shall relieve the Contractor and any other entity of their
13 obligations, duties and responsibilities including, but not limited to, construction means, methods,
14 sequence, techniques or procedures necessary for performing, superintending or coordinating all portions
15 of the work of construction in accordance with the contract documents and any health or safety
16 precautions required by any regulatory agencies. The Engineer and his or her personnel have no authority
17 to exercise any control over any construction contractor or other entity or their employees in connection
18 with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety.
19 The Engineer and the Engineer's consultants shall be indemnified and shall be made additional insureds
20 under the Contractor's general liability insurance policy.

21 **3.2 GENERAL INSTALLATION REQUIREMENTS**

- 22 A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit
23 requirements described within this Division shall be supplemental to the requirement described in Section
24 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and
25 labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted
26 and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- 27 B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the
28 installation as specified.
- 29 C. All cables and devices installed in damp or wet locations, including any underground or underslab location,
30 shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation
31 practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result
32 of being installed in a damp or wet location shall be replaced at the Contractor's expense.

33 **3.3 FIELD QUALITY CONTROL**

- 34 A. General:
- 35 1. Refer to specific Division 27 sections for further requirements.
- 36 2. The Contractor shall conduct all tests required and applicable to the work both during and after
37 construction of the work.
- 38 3. The necessary instruments and materials required to conduct or make the tests shall be supplied
39 by the Contractor who shall also supply competent personnel for making the tests who has been
40 schooled in the proper testing techniques.

- 1 4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such
2 adjustments, replacements and changes as are necessary and shall then repeat the test or tests
3 which disclose faulty or defective work or equipment, and shall make such additional tests as the
4 Architect/Engineer or code enforcing agency deems necessary.
- 5 5. All telecommunications tests that fail, including those due to excessive cabling lengths, shall be
6 remedied by the Contractor without cost to the project.
- 7 B. Protection of cable from foreign materials:
- 8 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign
9 material application or contact with any cable type. Foreign material is defined as any material
10 that would negatively impact the validity of the manufacturer's performance warranty. This
11 includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or
12 any other surface chemical, liquid or compound that could come in contact with the cable, cable
13 jacket or cable termination components.
- 14 2. Overspray of paint on any cable, cable jacket or cable termination component will not be
15 accepted. It shall be the Contractor's responsibility to replace any component containing
16 overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh
17 chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable
18 containing overspray. Should the manufacturer and warrantor of the structured cabling system
19 desire to physically inspect the installed condition and certify the validity of the structured cabling
20 system (via a signed and dated statement by an authorized representative of the structured
21 cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in
22 lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the
23 statement from the manufacturer, the Contractor shall also present to the Owner a letter from
24 the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to
25 be intact and acceptable.
- 26 **3.4 PROJECT CLOSEOUT**
- 27 A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs
28 supplement the requirements of Division 1.
- 29 B. Final Jobsite Observation:
- 30 1. The Engineer will not perform a final jobsite observation until the project is ready. This is not
31 dictated by schedule, but rather by completeness of the project.
- 32 2. Refer to the end of this specification section for a "STATEMENT INDICATING READINESS FOR FINAL
33 JOBSITE OBSERVATION."
- 34 3. The Contractor shall sign this form and return it to the Engineer so that the final observation can
35 commence.
- 36 C. Before final payment will be authorized, this Contractor must have completed the following:
- 37 1. Submitted electronic operation and maintenance manuals to the Architect/Engineer for review.
- 38 2. Submitted electronic copies of approved shop drawings.
- 39 3. Record documents including edited drawings and specifications accurately reflecting field
40 conditions, **inclusive** of all project revisions, change orders, and modifications.

- 1 4. Submitted a report stating the instructions given to the Owner's representative complete with the
2 number of hours spent in the instruction. The report shall bear the signature of an authorized
3 agent of This Contractor and shall be signed by the Owner's representative as having received the
4 instructions.
- 5 5. Submitted electronic testing reports for all systems requiring final testing as described herein.
- 6 6. Submitted electronic start-up reports on all equipment requiring a factory installation inspection
7 and/or start.
- 8 7. Provide spare parts, maintenance, and extra materials in quantities specified in individual
9 specification sections. Deliver to project site; submit receipt to Architect/Engineer prior to final
10 payment being approved.
- 11 8. Provide System Assurance Warranty certificate for the telecommunications system.

12 **3.5 OPERATION AND MAINTENANCE INSTRUCTIONS**

- 13 A. Electronic Submittal Procedures:
- 14 1. Distribution: Email the O&M manual as attachments to all parties designated by the
15 Architect/Engineer.
 - 16 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
 - 17 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper
18 originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission
19 restrictions on files; protected, locked, or secured documents will be rejected.
 - 20 4. File Names: Electronic submittal file names shall include the relevant specification section number
21 followed by a description of the item submitted, as follows. Where possible, include the
22 transmittal as the first page of the PDF instead of using multiple electronic files.
 - 23 a. O&M file name: O&M.div27.contractor.YYYYMMDD
 - 24 b. Transmittal file name: O&Mtransmittal.div27.contractor.YYYYMMDD
 - 25 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into
26 files that are clearly labeled as "1 of 2", "2 of 2", etc.
 - 27 6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital
28 video discs (DVD), or flash drives with a permanently affixed label, printed with the title
29 "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash
30 drive when multiple disc/flash drives are required.
 - 31 7. All text shall be searchable.
 - 32 8. Bookmarks shall be used, dividing information first by specification section, then systems, major
33 equipment and finally individual items. All bookmark titles shall include the nomenclature used in
34 the construction documents and shall be an active link to the first page of the section being
35 referenced.

36 **3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE**

- 37 A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care,
38 and operation of the complete systems installed under this contract.
- 39 B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY
40 PERSONNEL in the care, maintenance, and operation of the equipment and systems.

- 1 C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions
2 to facilitate this recording.
- 3 D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the
4 Owner's representative so that their representative can be present if desirable.
- 5 E. Refer to the individual specification sections for minimum hours of instruction time for each system.
- 6 F. Operating Instructions:
- 7 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on
8 the Communications Systems.
- 9 2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide
10 the required instructions on system operation, performance, troubleshooting, care and
11 maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the
12 Engineer to perform these services.

13 **3.7 SYSTEM COMMISSIONING**

- 14 A. The Communications Systems included in the construction documents are to be complete and operating
15 systems. The Architect/Engineer will make periodic job site observations during the construction period.
16 The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the
17 Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment
18 settings, software configuration, troubleshooting and verification of software, and final adjustments that
19 may be required.
- 20 B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- 21 C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure
22 that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the
23 purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment
24 operation, resolving installation and/or workmanship problems, equipment substitution issues or
25 unsatisfactory system performance, including call backs during the warranty period through no fault of the
26 design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the
27 Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor
28 shall be responsible for making payment to the Owner for services required that are product, installation or
29 workmanship related. Payment is due within 30 days after services are rendered.

30 **3.8 RECORD DOCUMENTS**

- 31 A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs
32 supplement the requirements of Division 1.
- 33 B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials
34 used.
- 35 C. This Contractor shall maintain at the job site, a separate and complete set of Communications Drawings
36 which shall be clearly and permanently marked and noted in complete detail any changes made to the
37 location and arrangement of equipment or made to the Communications Systems and wiring as a result of
38 building construction conditions or as a result of instructions from the Architect or Engineer. All Change
39 Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the
40 documents. Record documents that merely reference the existence of the above items are not acceptable.
41 Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall
42 reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement.
43 Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.

1 D. The above record of changes shall be made available for the Architect and Engineer's examination during
2 any regular work time.

3 E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up
4 drawings to the Architect/Engineer.

5 **3.9 ADJUST AND CLEAN**

6 A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the
7 project.

8 B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from
9 equipment.

10 C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the
11 premises.

12 **END OF SECTION**

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 requirements.

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.

1 **Telecommunications – Proof of Certification**

2 There are specific Contractor qualification requirements for this project as defined in specification section 27 05 00, which may
3 include Manufacturer Certification. This Proof of Certification document and the supporting documentation require herein, is
4 required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

5 Statement of Compliance:

6 The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer _____.
7 Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install
8 all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all
9 product, labor and system assurance warranties required for this project by these contract documents.

10 The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of
11 _____, 20____.

12 The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does
13 not also meet this certification requirement.

14 Contractor Company Name: _____

15 Authorized Representative: (print) _____

16 Date: _____ Manufacturer Certification Number (if any): _____

17

18 Submit the following with the bid:

- 19 • This form.
20 • Proof of Manufacturer Certification indicated above.

1
2
SECTION 27 05 26
COMMUNICATIONS BONDING

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Bonding Conductors
6 B. Bonding Connectors
7 C. Grounding Busbar (TMGB and TGB)
8 D. Rack-mount Telecommunications Grounding Busbar

9 **1.2 REFERENCES**

- 10 A. ANSI/IEEE 1100 – Recommended Practice for Power and Grounding Sensitive Electronic Equipment in
11 Industrial and Commercial Power Systems
12 B. ANSI/TIA/EIA 568-B.1-B.3 – Commercial Building Telecommunications Cabling Standard
13 C. ANSI/TIA/EIA 569-A – Commercial Building Standard for Telecommunications Pathways and Spaces
14 D. ANSI/TIA/EIA 606 – Administration Standard for the Telecommunications Infrastructure of Commercial
15 Buildings
16 E. ANSI/TIA/EIA 758 – Customer Owned Outside Plant
17 F. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements for
18 Telecommunications
19 G. IEEE 81 – IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a
20 Ground System Part 1: Normal Measurements
21 H. IEEE 837 – IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding
22 I. NFPA 70 – National Electrical Code
23 J. NFPA 780 – Standard for the Installation of Lightning Protection Systems
24 K. UL 96 – Lightning Protection Components
25 L. UL 96A – Installation Requirements for Lightning Protection Systems
26 M. UL 467 – Grounding and Bonding Equipment

27 **1.3 RELATED SECTIONS**

- 28 A. Section 26 05 33 – Conduit
29 B. Section 26 05 36 – Cable Trays
30 C. Section 26 05 13 – Wire and Cable
31 D. Section 26 05 26 – Grounding and Bonding
32 E. Section 27 05 00 – Basic Communications Systems Requirements
33 F. Section 27 11 00 – Communication Equipment Rooms
34 G. Section 27 05 28 – Interior Communication Pathways
35 H. Section 27 05 43 – Exterior Communications Pathways
36 I. Section 27 05 53 – Identification and Administration

1 **1.4 SYSTEM DESCRIPTION**

2 A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete
3 turnkey communications bonding system, including connection to the electrical ground grid.

4 B. Performance Statement: This specification section and the accompanying drawings are performance based,
5 describing the minimum material quality, required features, operational requirements, and performance of
6 the system. These documents do not convey every wire that must be installed, every equipment
7 connection that must be made, or every feature and function that must be configured. Based on the
8 equipment constraints described and the performance required of the system as presented in these
9 documents, the Contractor is solely responsible for determining all components, devices, equipment,
10 wiring, connections, and terminations required for a complete and operational system that provides the
11 required performance.

12 C. This document describes the major components of the system. All additional hardware, subassemblies,
13 supporting equipment, and other miscellaneous equipment required for complete, proper system
14 installation and operation shall be provided by the Contractor.

15 D. Basic System Requirements:

16 1. A complete communications bonding infrastructure is required for this project. Refer to the
17 drawings and the requirements of ANSI-J-STD-607-A and NFPA 70 for complete information.

18 2. The bonding system shall include, but not be limited to, the following major components:

- 19 a. Bonding Conductor for Telecommunications (BCT)
- 20 b. Telecommunications Main Grounding Busbar (TMGB)
- 21 c. Telecommunications Bonding Backbone (TBB)
- 22 d. Telecommunications Grounding Busbar(s) (TGB)
- 23 e. Rack mount Telecommunications Grounding Busbar(s)
- 24 f. Bonding Conductor(s) (BC)
- 25 g. Bonding Connectors
- 26 h. Bonding system labeling and administration as defined in Section 27 05 53.

27 **1.5 QUALITY ASSURANCE**

28 A. Refer to Section 27 05 00 for relevant standards.

29 B. Communications bonding system component, device, equipment, and material manufacturer(s) shall have a
30 minimum of five (5) years documented experience in the manufacture of communications bonding
31 products.

32 C. The entire installation shall comply with all applicable electrical codes, safety codes, and standards. All
33 applicable components, devices, equipment, and material shall be listed by Underwriters' Laboratories, Inc.

34 **1.6 SUBMITTALS**

35 A. Submit product data and shop drawings under provisions of Section 27 05 00 and Division 1.

36 B. Provide manufacturer's technical product specification sheet for each individual component type.
37 Submitted data shall show the following:

38 1. Compliance with each requirement of these documents. The submittal shall acknowledge each
39 requirement of this section, item-by-item, including construction, materials, ratings, and all other
40 parameters identified in Part 2 - Products.

- 1 2. Manufacturer's installation instructions indicating application conditions and limitations of use
2 stipulated by product testing agency. Include instructions for storage, handling, protection,
3 examination, preparation, installation, and starting of product.
- 4 C. Provide CAD-generated, project-specific system shop drawings as follows:
- 5 1. Provide a system block diagram indicating system configuration, system components,
6 interconnection between components, and conductor routing. The diagram shall clearly indicate
7 all wiring and connections required in the system. When multiple devices or pieces of equipment
8 are required in the exact same configuration (e.g., multiple identical equipment racks or sections
9 of ladder tray), the diagram may show one device and refer to the others as "typical" of the device
10 shown. The diagram shall list room numbers where system equipment will be located.
- 11 2. Installation details for all system components.
- 12 D. Provide system checkout test procedure to be performed at acceptance.
- 13 **1.7 DELIVERY, STORAGE, AND HANDLING**
- 14 A. Deliver products to the site under the provisions of Section 27 05 00.
- 15 B. Store and protect products under the provisions of Section 27 05 00.
- 16 C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products
17 shall not be acceptable for use on this project.
- 18 **1.8 PROJECT RECORD DOCUMENTS**
- 19 A. Submit documents under the provisions of Section 27 05 00.
- 20 B. Provide final system block diagram showing any deviations from approved shop drawing submittal.
- 21 C. Provide floor plans that document the following:
- 22 1. Actual locations of system components, devices, and equipment.
23 2. Actual conductor routing.
24 3. Actual system component, device, equipment, and conductor labels.
- 25 D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is
26 complete and test results were satisfactory.
- 27 E. Complete all operation and maintenance manuals as described below.
- 28 **1.9 OPERATION AND MAINTENANCE DATA**
- 29 A. Submit under provisions of Section 27 05 00.
- 30 B. Submitted data shall include:
- 31 1. Approved shop drawings.
- 32 2. Descriptions of recommended system maintenance procedures, including:
- 33 a. Inspection
34 b. Periodic preventive maintenance
35 c. Fault diagnosis
36 d. Repair or replacement of defective components

1 **PART 2 - PRODUCTS**

2 **2.1 BONDING CONDUCTORS**

3 A. Bare Copper:

- 4 1. Annealed uncoated stranded conductor.
5 2. Minimum size 6 AWG.

6 B. Insulated Copper:

- 7 1. Annealed uncoated stranded conductor.
8 2. Insulation:
9 a. PVC insulation with nylon outer jacket.
10 b. Rated \geq 600 volts.
11 c. Green.
12 3. Minimum size 6 AWG.

13 C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being
14 suitable for the intended purpose and for installation in the space in which they are installed.

15 D. Bonding Conductor Sizing

16 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

17 2. The BCT shall be the same size as the TBB or larger.

18 **2.2 BONDING CONNECTORS**

19 A. Acceptable Types:

- 20 1. Two-hole compression lug
21 2. Exothermic weld
22 3. Irreversible compression

23 B. Connectors shall be provided in kit form and selected per manufacturer's written instructions.

24 C. Connectors shall comply with IEEE 837 and UL 467 and be listed for use for specific types, sizes, and
25 combinations of conductors and connected items.

1 **2.3 GROUNDING BUSBAR (TMGB AND TGB)**

2 A. Features:

- 3 1. Wall-mount configuration.
- 4 2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended
- 5 purpose.
- 6 3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-A standards.
- 7 4. Predrilled holes.
- 8 5. Integral insulators.
- 9 6. Stainless steel offset mounting brackets.

10 B. Specifications:

- 11 1. Material: Electrolytic tough pitch copper bar.
- 12 2. Minimum Dimensions: 1/4" thick x 4" high x 12" long.
 - 13 a. Increase dimensions and/or quantity furnished and installed as required to
 - 14 accommodate all terminations required by the project, plus 20% spare capacity.
- 15 3. Hole pattern shall include:
 - 16 a. A minimum of 15 sets of 5/16" holes, 5/8" on center, to accommodate "A" spaced 2-
 - 17 hole compression lugs.
 - 18 b. A minimum of three (3) sets of 7/16" holes, 1" on center, to accommodate "C" spaced
 - 19 2-hole compression lugs.

20 **2.4 RACK-MOUNT TELECOMMUNICATIONS GROUNDING BUSBAR**

21 A. Features:

- 22 1. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended
- 23 purpose.
- 24 2. Predrilled holes.
- 25 3. Mounts in a standard 19" equipment rack.

26 B. Specifications:

- 27 1. Material: Electrolytic tough pitch copper bar.
- 28 2. Minimum Dimensions: 3/16" thick x 3/4" high x 19" long.
 - 29 a. Increase dimensions and/or quantity furnished and installed as required to
 - 30 accommodate all terminations required by the project, plus 20% spare capacity.
- 31 3. Hole pattern shall include:
 - 32 a. A minimum of eight (8) 6-32 tapped lug mounting holes on 1" centers.
 - 33 b. A minimum of two (2) pairs of 5/16" diameter holes spaced 3/4" apart.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

3 A. General Bonding Requirements:

- 4 1. The communications bonding system shall be a complete system. Contractor shall furnish and
5 install all necessary miscellaneous components, devices, equipment, material, and hardware,
6 including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs,
7 insulators, mounting screws, lugs, etc., to provide a complete system.
- 8 2. A licensed electrician shall perform all bonding.
- 9 3. Comply with the manufacturer's instructions and recommendations for installation of all
10 products.

11 B. Main Cross Connect and Service Entrance Room Bonding Requirements:

- 12 1. Locate the TMGB in the service entrance room unless otherwise noted on the drawings.
- 13 2. The location of the TMGB shall be the shortest practical distance from the telecommunications
14 primary lightning protection devices.
- 15 3. Bond the telecommunications primary protectors to the TMGB. Maintain a minimum 1 foot (300
16 mm) separation of the bonding conductor from all DC power cables, switchboard cable, and high
17 frequency cable.

18 C. Telecommunications Main Ground Bar (TMGB) Requirements:

- 19 1. Install TMGB such that it is insulated from its support with a minimum 2" standoff.
- 20 2. Bond the TMGB to the electrical service ground via the BCT.
- 21 a. A minimum of 1 foot (300 mm) separation shall be maintained between the BCT and any
22 DC power cables, switchboard cable, or high frequency cables.
- 23 3. Where backbone or horizontal cabling contains a shield, the shield(s) shall be bonded to the
24 TMGB.
- 25 4. TMGB shall be bonded to all electrical panels located in the same room or space as the TMGB or
26 in an immediately adjacent space within 20 linear feet of the TMGB. TMGB shall be bonded to all
27 electrical panels providing electrical power to communications equipment located in the same
28 room or space as the TMGB.
- 29 5. TMGB shall be bonded to accessible metallic building structure located within the same room or
30 space as the TMGB.
- 31 6. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays,
32 ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located
33 within the same room or space as the TMGB, shall be bonded to the TMGB.
- 34 7. All metallic communications equipment, including, but not limited to, cable pair protectors, surge
35 suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the
36 same room or space as the TMGB, shall be bonded to the TMGB.

- 1 D. Telecommunications Ground Bar (TGB) Requirements:
- 2 1. Provide a TGB in each telecommunications equipment room.
- 3 2. Install TGB such that it is insulated from its support with a minimum 2" standoff.
- 4 3. Bond each TGB to the TMGB via the TBB.
- 5 a. A minimum of 1 foot (300 mm) separation shall be maintained between the TBB and any
6 DC power cables, switchboard cable, or high frequency cables.
- 7 b. The TBB may be routed from TGB to TGB or as a radial feed to each TGB as the layout
8 requires.
- 9 4. When there are multiple telecommunications equipment rooms on each floor in buildings
10 containing more than five stories, the TGBs on the same floor shall be bonded together
11 horizontally using a grounding equalizer (GE) on the first, last, and every third intermediate floor.
12 GE conductors shall be the same size as the TBB.
- 13 5. If more than one (1) TGB is provided within the same room or space, they shall all be bonded
14 together via a BC the same size as the TBB.
- 15 6. Where horizontal cabling contains a shield, the shield(s) shall be bonded to the TGB.
- 16 7. TGBs shall be bonded to accessible metallic building structure located within the same room or
17 space as the TGBs.
- 18 8. TGBs shall be bonded to all electrical panels located in the same room or space as the TGB or in an
19 immediately adjacent space within 20 linear feet of the TGB. TGBs shall be bonded to all electrical
20 panels providing electrical power to communications equipment located in the same room or
21 space as the TGB.
- 22 9. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays,
23 ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located
24 within the same room or space as the TGB, shall be bonded to the TGB.
- 25 10. All metallic communications equipment, including, but not limited to, cable pair protectors, surge
26 suppressors, cross-connect frames, patch panels, equipment cabinets, etc., located within the
27 same room or space as the TGB, shall be bonded to the TGB.
- 28 E. Rack-mount Telecommunications Ground Bar Requirements (RTGB):
- 29 1. Provide a rack-mount telecommunications ground bar in each equipment rack and equipment
30 rack enclosure.
- 31 2. Install RTGB such that it is electrically bonded to the rack. Where necessary, remove paint and/or
32 use paint-piercing washers to provide proper electrical bond between RTGB and equipment rack.
- 33 3. Bond each RTGB to the TGB via a BC.
- 34 4. If more than one (1) RTGB is provided within the same room or space, they shall all be bonded
35 together via a BC.
- 36 5. Where horizontal cabling containing a shield is terminated on rack-mounted termination
37 hardware, the shield(s) shall be bonded to the RTGB.

- 1 6. All contractor-furnished and/or contractor-installed metallic communications equipment,
2 including, but not limited to patch panels, fiber optic distribution enclosures, splice enclosures,
3 active electronics, uninterruptible power supplies, etc., mounted within the same equipment rack
4 as the RTGB, shall be bonded to the RTGB. Where necessary, remove paint and/or use paint-
5 piercing washers to provide proper electrical bond between equipment rack and installed metallic
6 communications equipment. Active electronics and uninterruptible power supplies shall be
7 bonded to the RTGB via a dedicated BC for each device.
- 8 F. Metallic Interior Communication Pathway Bonding Requirements:
- 9 1. All metallic interior continuous communication cable pathways, including, but not limited to,
10 conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder
11 rack, shall be bonded to the communications bonding system.
- 12 G. Bonding Conductor Requirements:
- 13 1. Bonding conductors shall be green or marked with a distinctive green color.
- 14 2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest
15 and straightest paths possible. Number of bends and changes in direction should be minimized.
16 Install and secure conductors in a manner that protects the conductors from impact and from
17 physical or mechanical strain or damage.
- 18 3. Bonding conductors shall not be installed in metallic conduit.
- 19 4. All conductors, including, but not limited, to the BCT, TBB, and BC(s), shall be installed splice-free.
20 If the Contractor believes that site conditions do not allow a splice-free installation, the
21 Contractor may request permission from the Engineer to splice a specific communications
22 bonding system conductor.
- 23 a. Where documented permission to splice a conductor is granted:
- 24 1) The number of splices shall be limited to as few as possible.
- 25 2) Splices shall be made using exothermic welding or irreversible compression-
26 type connections only. Splice hardware shall be listed for grounding and
27 bonding. Solder is not an acceptable means of splicing conductors.
- 28 3) Splices shall be made in telecommunications spaces in accessible locations to
29 facilitate future inspection and maintenance.
- 30 4) Splices shall be adequately supported and protected from impact and from
31 physical or mechanical strain or damage.
- 32 5. All bonding conductors shall be labeled in accordance with the requirements of Section 27 05 53.
33 In addition to the requirements of Section 27 05 53:
- 34 a. Labels shall be nonmetallic.
- 35 b. Labels shall be printer-generated.
- 36 c. Labels shall be located on conductors as close as is practical to their point of termination
37 in a readable position.
- 38 d. Additionally, conductors shall be labeled as follows:
- 39 1) “IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE
40 CALL THE BUILDING TELECOMMUNICATIONS MANAGER.”

- 1 6. Interior water piping is not acceptable for use as a communications bonding system bonding
2 conductor.
- 3 7. Metallic cable shields are not acceptable for use as communications bonding system bonding
4 conductors.
- 5 H. Bonding Connection Requirements:
- 6 1. Make all connections in accessible locations to facilitate future inspection and maintenance.
- 7 2. Communications bonding system connections shall be made using exothermic welding, two-hole
8 compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is
9 prohibited, except for connections to a rack-mount telecommunications ground bar. Connection
10 hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to
11 make communications bonding system connections.
- 12 3. Thoroughly clean conductors before installing lugs and connectors.
- 13 4. Install and tighten all connectors in accordance with manufacturer's instructions, using the
14 appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose.
15 Exercise care not to tighten connectors beyond manufacturer's recommendations.
- 16 5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical
17 bond at all connections.
- 18 6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed
19 and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in
20 accordance with manufacturer's recommendations and instructions.
- 21 7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric
22 grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat
23 shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector
24 and be installed in accordance with manufacturer's recommendations and instructions.

25 **3.2 FIELD QUALITY CONTROL**

- 26 A. Field testing shall be performed under provisions of Section 27 05 00.
- 27 B. Where these specifications require a product or assembly without the use of a brand or trade name,
28 provide a product from a reputable manufacturer that meets the requirements of the specifications.
- 29 C. Periodic observations will be performed during construction to verify compliance with the requirements of
30 the specifications. These services do not relieve the Contractor of responsibility for compliance with the
31 contract documents.

32 **3.3 ADJUSTING**

- 33 A. Adjust work under provisions of Section 27 05 00.
- 34 B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure
35 that the installed system meets all requirements listed herein. Modifications necessary to comply with
36 listed requirements or to provide specified performance shall be completed by the Contractor at no
37 additional cost to the Owner.

38 **3.4 TESTING**

- 39 A. Test installed system under provisions of Section 27 17 10.

- 1 B. Measure and document resistance to ground at TMGB, each TGB, each RTGB, and each electrical
2 distribution panel bonded to the TMGB or a TGB.
- 3 1. Measurements shall be made not less than two full days after the last trace of precipitation, and
4 without the soil being moistened by any means other than natural drainage or seepage, and
5 without chemical treatment or other artificial means of reducing natural ground resistance.
6 Perform tests by the fall-of-potential method according to IEEE 81.
- 7 2. Measured resistance to ground at TMGB, each TGB, and each RTGB must not exceed 5 ohms.
- 8 3. Under no circumstances shall any point in the communications bonding system have a lower
9 resistance to ground than that of nearby electrical distribution system components that it is
10 bonded to.
- 11 C. Include measurement documentation in test data submitted at completion of project under provisions of
12 Section 27 17 10.

13 **3.5 SYSTEM TRAINING**

- 14 A. All labor and materials required for on-site system training shall be provided. Training shall be conducted at
15 the project site using the project equipment.
- 16 1. Provide two week's advanced notice of training to the Owner and Engineer.
- 17 2. The Engineer shall be presented with the option to attend the training.
- 18 3. Provide a training outline agenda describing the subject matter and the recommended audience
19 for each topic.
- 20 B. At a minimum, the following training shall be conducted:
- 21 1. A course detailing the system functions and operations that a technical user will encounter.
22 Provide training on all aspects of using the system, including making new bonding connections to
23 the TMGB, TGB, or RTGB. Provide training on all recommended inspection, maintenance, and
24 repair procedures for the system.
- 25 C. Minimum on-site training times shall be:
- 26 1. Technical user: Two hours.

27 **END OF SECTION**

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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 26 05 36 – Cable Trays
- C. Section 27 05 00 - Basic Communications Systems Requirements
- D. 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.

1 **PART 2 - PRODUCTS**

2 **2.1 CONDUIT**

3 A. Refer to Section 26 05 33 for conduit requirements for this project.

4 **2.2 WIRE MESH CABLE TRAY – OVERHEAD AND UNDERFLOOR**

5 A. Acceptable Manufacturers:

- 6 1. Cooper B-Line "Flextray"
- 7 2. Cablofil, Inc.
- 8 3. Wiremold "Fieldmate"

9 B. General: Provide wire mesh of types and sizes indicated on drawings; with connector assemblies, clamp
10 assemblies, connector plates, splice plates and splice bars. Provide drop-out fittings where cable tray is
11 installed over equipment racks. Two drop-out fittings shall be installed over each rack so that a controlled
12 radius is maintained into each side of every equipment rack that cable tray passes over. Construct units with
13 rounded edges and smooth surfaces; in compliance with applicable standards; and with the following
14 additional construction features.

15 C. Wire mesh shall be made of high strength steel wires and formed into a standard 2 inch by 4 inch wire mesh
16 pattern with intersecting wires welded together. All wire ends along wire mesh sides (flanges) shall be
17 rounded during manufacturing for safety of cables and installers.

18 D. Materials and Finishes: Material and finish specifications for each wire mesh type are as follows:

19 1. Electro-Galvanized Zinc: Straight sections shall be made from steel meeting the minimum
20 mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM
21 B633 SC2. Additionally, straight sections shall be painted Flat Black.

22 2. Accessories:

23 a. Pre-Galvanized Zinc: Wall brackets and other pre-galvanized accessories shall be coated
24 with zinc in accordance with ASTM A653.

25 b. Electro-Galvanized Zinc: Support accessories and miscellaneous hardware shall be
26 coated in accordance with ASTM B633 SC3. All threaded components shall be coated in
27 accordance with ASTM B633 SC1.

28 c. Cable tray shall be provided with bend radius control fittings at all inside corners.

29 E. Type of Overhead Wire Mesh Support System:

30 1. All straight section longitudinal wires shall be straight (with no bends).

31 2. Wire mesh supports shall be trapeze hangers or wall brackets. Center hung supports will not be
32 allowed.

33 3. Trapeze hangers are to be supported by 1/4 inch or 3/8-inch diameter rods.

34 4. Provide manufacturer approved grounding clips as necessary for continuous grounding of tray.

35 F. Type of Underfloor Wire Mesh Support System:

36 1. All straight section longitudinal wires shall be straight (with no bends).

1 2. Wire mesh supports shall be securely mounted to raised floor pedestals. Top of tray shall be 2"
2 below accessible floor tile.

3 3. Provide manufacturer approved grounding clips as necessary for continuous grounding of tray.

4 **2.3 CABLE HANGERS AND SUPPORTS**

5 A. Provide a non-continuous cable support system suitable for use with open cable.

6 B. Cable Hooks:

7 1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall
8 have 90-degree radius edges.

9 2. All cable hook mounting hardware shall be recessed to prevent damage to cable during
10 installation. Installed cabling shall be secured using a cable latch retainer that shall be removable
11 and reusable.

12 3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use.

13 C. Cable Hangers:

14 1. Adjustable, non-continuous cable support slings for use with low voltage cabling.

15 2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material
16 shall be suitable for use in plenum environments.

17 3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.

18 4. Cabling hanger load limit shall be 100 lbs per foot.

19 5. Manufacturer: Erico Caddy, CableCat CAT425, Arlington Fittings TI Series or approved equal.

20 **PART 3 - EXECUTION**

21 **3.1 CABLE HOOK SUPPORT SYSTEM**

22 A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit,
23 such cabling shall be supported by an approved cable hook support system.

24 B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a
25 40% fill capacity be exceeded.

26 C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side
27 travel of any cable hook exceed 6".

28 D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting
29 a minimum of 30 pounds with a safety factor of 3.

30 E. Support spans shall be based on the manufacturer's load ratings. In no case shall a 5-foot span be
31 exceeded.

32 F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling
33 support specified herein.

34 G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks
35 specified herein.

1 **3.2 CONDUIT AND CABLE ROUTING**

- 2 A. Refer to specification section 26 05 03 for additional requirements.
- 3 B. All conduits shall be reamed and shall be installed with a nylon bushing.
- 4 C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less,
5 maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter
6 greater than 2", maintain a bend radius of at least 10 times the internal diameter.
- 7 D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.
- 8 E. Any conduit exceeding 90' in length or containing more than three (3) 90-degree bends shall contain a pull
9 box sized per ANSI/TIA/EIA 569 requirements.
- 10 1. A separate pull box is required for each 90' (or greater) length section.
- 11 2. A separate pull box is required after any two (2) consecutive 90-degree bends.
- 12 3. Pull box shall be located in an area that maintains accessibility of box, including the ability to
13 remove box lid without removal or relocation of any other materials.
- 14 F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity de-rated by 15% for each 90
15 degrees of cumulative bend.
- 16 G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the
17 Contractor's expense, after the conduit condition has been remedied.

18 **3.3 WIRE MESH TRAY INSTALLATION**

- 19 A. The wire mesh cable tray system shall be only for telecommunications.
- 20 B. Install wire mesh as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to
21 ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA
22 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
- 23 C. Cable tray sections shall be grounded in accordance with manufacturer's recommendations using
24 manufacturer approved hardware. Painted sections shall have paint removed at each grounding attachment
25 point.
- 26 D. Test wire mesh support systems to ensure electrical continuity of bonding and grounding connections, and
27 to demonstrate compliance with specified maximum grounding resistance. Refer to NFPA 70B, Chapter 18,
28 for testing and test methods.
- 29 E. Provide sufficient space encompassing wire mesh to permit access for installing and maintaining cables.
- 30 F. Tray shall be continuous from source to termination and shall not change elevation, direction or otherwise
31 expose cables to travel without 2" x 4" mesh support.
- 32 G. Overhead and Underfloor Tray shall be field cut using only manufacturer approved cutting device and
33 methods. Cutting device shall be an offset blade bolt cutter; standard bolt cutters are specifically not
34 permitted. Drop-in tray sections shall not be field cut or field modified in any way.
- 35 H. Bends in overhead and underfloor tray shall be accomplished by utilizing manufacturer's cutting guides.
- 36 I. All splices of tray shall be provided with splice washers, bars or springs as recommended by the
37 manufacturer.

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SECTION 27 05 53
IDENTIFICATION AND ADMINISTRATION

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

5 A. This section describes the execution and administration requirements relating to the structured cabling
6 system and its termination components and related subsystems.

7 B. Identification and labeling.

8 **1.2 RELATED SECTIONS**

9 A. Section 27 05 00 – Basic Communications Systems Requirements

10 **1.3 QUALITY ASSURANCE**

11 A. Refer to section 27 05 00 for relevant standards.

12 **1.4 SUBMITTALS**

13 A. Under the provisions of Section 27 05 00 and Division 1, prior to the start of work the Contractor shall
14 submit:

15 1. Documentation of labeling scheme.

16 **PART 2 - PRODUCTS**

17 **2.1 LABELING**

18 A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion.
19 Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.

20 B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.

21 C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size,
22 color, typeface and attachment method.

23 D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to
24 USS-128.

25 1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum "quiet zone"
26 of 0.25" on each side of the bar code.

27 2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by
28 themselves are not acceptable.

29 E. Color Code: Observe the following requirements for color coding:

30 1. Labels on each end of a cable shall be the same color for each termination.

31 2. Labels for cross-connects shall be two different colors at each termination fields, representative of
32 the color of that field.

33 3. Orange (Pantone 15C) shall be used for the demarcation point.

- 1 4. Green (Pantone 353C) shall be used for the termination point of network connection on the
2 facility side of the demarc.
- 3 5. Purple (Pantone 264C) shall be used to identify the termination of cables from common
4 equipment (PBX, computers, LANS, etc.)
- 5 6. White shall be used to identify the first-level backbone termination in the main cross-connect.
- 6 7. Blue (Pantone 291C) shall be used to identify the termination of station cabling at the
7 telecommunications closet and/or equipment room end of the cable.
- 8 8. Brown (Pantone 465C) shall be used to identify the termination of the interbuilding backbone
9 cable terminations.
- 10 9. Yellow (Pantone 101C) shall be used to identify the termination of auxiliary circuits, alarms,
11 maintenance, security, etc.
- 12 10. In facilities that do not contain a main cross-connect, the color white may be used to identify
13 second-level backbone terminations.
- 14 F. Tag all CAT 6, CAT 6A, and optical fiber cables at both the Communications Equipment Room and the
15 information outlets. Coordinate labeling scheme with City of Madison staff during Pre-installation meeting.

16 **2.2 DOCUMENTATION/AS-BUILTS/RECORDS**

- 17 A. General:
- 18 1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of
19 Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections
20 below.
- 21 2. All documentation, including hard copy and electronic forms shall become the property of the
22 Owner.
- 23 B. Record Drawings:
- 24 1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified
25 by their sequential number as defined elsewhere in this document. Numbering, icons and drawing
26 conventions used shall be consistent throughout all documentation provided.

27 **PART 3 - EXECUTION**

28 **3.1 IDENTIFICATION AND LABELING**

- 29 A. Cable Labeling: Backbone and horizontal cables shall be labeled at each end.
- 30 1. Provide additional cable labeling at each handhole, manhole, and pull box, as applicable.
- 31 2. Cables that are routed through multiple pathway segments shall contain reference to all pathway
32 segments in the pathway linkage field.
- 33 3. Cables that differ only by performance class shall have a suitable marking or label to indicate the
34 higher performance class. For example, station cabling utilizing the blue color, may include blue
35 with a white stripe to indicate the higher performance class station cabling.
- 36 B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.

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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.

1 **2.2 EQUIPMENT RACKS**

- 2 A. Where identified on the drawings in Communication Equipment Rooms, equipment racks shall be furnished
3 and installed by the Contractor to house cable termination components (e.g., copper, optical fiber, coax)
4 and network electronics.
- 5 B. The equipment rack shall conform to the following requirements:
- 6 1. Standard TIA/EIA 19" Floor Rack:
- 7 a. Equipment rack shall be 84" in height, self-supporting and provide a useable mounting
8 height of 45 rack units (RU) (1 RU = 1 ¾").
- 9 b. Channel uprights shall be spaced to accommodate industry standard 19" mounting.
- 10 c. Equipment rack shall be double side drilled and tapped to accept 12-24 screws. Uprights
11 shall also be drilled on back to accept cable brackets, clamps, power strip(s), etc. Hole
12 pattern on rack front shall be per TIA/EIA specifications (5/8"-5/8"-1/2"). Hole pattern
13 on the rear shall be at 3" intervals to accept cable brackets.
- 14 d. Equipment racks shall be provided with a supply of spare screws (minimum of 24).
- 15 e. Equipment racks shall be provided with a ground bar and #6 AWG ground lug.
- 16 f. Provide all mounting hardware and accessories as required for a complete installation.

17 **2.3 CABLE MANAGEMENT – VERTICAL AND HORIZONTAL**

- 18 A. Equipment Racks:
- 19 1. Equipment racks shall be equipped with vertical and horizontal cable management hardware in
20 the form of rings and guides. Racks shall incorporate vertical and horizontal covers, to allow an
21 orderly, hidden, routing of copper, optical fiber, and coax jumpers from the modular patch panels
22 and/or 110-type termination blocks to the customer provided network electronics. Vertical and
23 horizontal cable management hardware shall be as follows:
- 24 a. Horizontal cable management hardware shall be painted steel (3.5" panel), have a
25 minimum of five (5) jumper distribution rings (1.75" x 3.75" minimum dimension) and
26 incorporate jumper routing clips (plastic) for individual jumpers. Provide with cover
27 designed to conceal and protect cable.
- 28 b. At a minimum, horizontal cable management hardware shall be positioned above and
29 below (a) each grouping of two rows of jacks on modular patch panels, and (b) above
30 and below each optical fiber patch panel and (c) each grouping of two rows of F-type
31 connectors on coax patch panels.
- 32 c. Vertical cable management hardware shall provide for cable routing on front and rear of
33 each rack and be 3½" square (minimum). Vertical cable management hardware shall
34 mount on spacers attached to the rack uprights and not on the upright itself. Where
35 multiple equipment racks are to be installed, this hardware shall be mounted between
36 the uprights of adjacent equipment racks. Equipment rack uprights and the spacers
37 shall be secured together per manufacturer's recommendations. Provide with cover
38 designed to conceal and protect cable.
- 39 2. Each equipment rack shall be supplied with a minimum of 12 releasable (e.g., "hook and loop")
40 cable support ties.

- 1 3. Where cable termination hardware is wall-mounted, the Contractor shall be responsible for
2 establishing a cable pathway for jumpers routed from the equipment rack(s) to the wall. This shall
3 be in the form of slotted ducts or troughs. Routing of jumpers via the overhead cable tray or
4 ladder rack system is NOT acceptable. The proposed method shall be included in the submittals
5 required by this document and shall be approved by the Engineer prior to installation.

6 **2.4 PATCH PANELS**

- 7 A. Where identified on the drawings in Communication Equipment Rooms, modular patch panels shall be
8 furnished and installed by the Contractor for termination of copper cable.
- 9 B. Copper cabling shall be terminated in Communication Equipment Rooms on modular patch panels
10 consisting of a modular connector system incorporating modular jacks meeting the specifications for the
11 jacks detailed in Section 27 15 00.
- 12 C. The largest single modular patch panel configuration shall not exceed 48-Ports. Modular patch panels shall
13 be fully populated (all ports occupied by jacks) and be provided in increments of no less than 12 jacks. High-
14 density modular patch panels will not be accepted.
- 15 D. The modular patch panel blocks shall have the ability to seat and cut eight (8) conductors (4 pairs) at a time
16 and shall have the ability of terminating 22- through 26-gauge plastic insulated, solid and stranded copper
17 conductors. Modular patch panel blocks shall be designed to maintain the cables' pair twists as closely as
18 possible to the point of mechanical termination.
- 19 E. Modular patch panels shall incorporate cable support and/or strain relief mechanisms to secure the
20 horizontal cables at the termination block and to ensure that all manufacturers minimum bend radius
21 specifications are adhered to.

22 **2.5 LADDER RACK**

- 23 A. Provide complete ladder rack system including metallic ladder rack, splice connectors, fastening hardware
24 and other miscellaneous materials as required for a complete installation per manufacturer's
25 recommendations.
- 26 B. Steel C-Channel Stringer Style Ladder Rack:
- 27 1. Rolled steel siderail stringer, 1-1/2" stringer height, 9" spaced welded rungs.
- 28 2. Steel shall meet the requirements of ASTM A1011 SS Grade 33.
- 29 3. Loading limits shall be 292 lbs/ft for 4 ft spans.
- 30 C. Ladder rack finish shall be flat black powder coat.

31 **2.6 D-RINGS**

- 32 A. Rounded edge D-rings for support of cabling in vertical and horizontal configurations.
- 33 B. EIA 310D compliant, manufactured from materials meeting UL94-V0 specifications.
- 34 C. Provide ¼" screw holes for wall mounting.

35 **2.7 POWER STRIPS**

- 36 A. Provide power strips on all equipment racks, unless noted otherwise. These power strips shall have the
37 following characteristics:

- 1 1. Standard Rack Mount:
- 2 a. TIA/EIA 19" equipment rack mountable.
- 3 b. Compliant with UL-1283, UL-1449 Second Edition and UL-497A.
- 4 c. Provide transient suppression to 13,000-A. Protection shall be in all three modes (line-
5 neutral, line-ground and neutral-ground).
- 6 d. Shall meet or exceed ANSI C62 Category A3 requirements.
- 7 e. Provide high-frequency noise suppression as follows:
8 >20-dB @ 50 kHz
9 >40-dB @ 150 kHz
10 >80-dB @ 1 MHz
11 >30-dB @ 6 to 1000 MHz
- 12 f. Provide a minimum of 320 joules of AC energy absorption.
- 13 g. Be equipped with a 12-foot power cord.
- 14 h. Shall meet or exceed IEEE 587 Category A & B Specification.

15 **PART 3 - EXECUTION**

16 **3.1 EQUIPMENT RACKS**

- 17 A. Equipment racks shall be furnished and installed as shown on the drawings.
- 18 B. The Contractor shall bolt the rack to the floor as recommended by the manufacturer. Multiple racks shall
19 be joined and the ground made common on each. The rack shall be stabilized by extending a brace to the
20 wall. Alternately, overhead ladder rack by which the cabling accesses the equipment rack(s) may provide
21 this function.
- 22 C. A space between the rack upright and the wall (approximately 4") should be provided to allow for cabling in
23 that area. The rear of the rack should be approximately 40" from the wall to allow for access by
24 maintenance personnel. In all cases, a minimum of 40" workspace in front of the rack is also required.
25 Locations where these guidelines cannot be followed should be brought to the attention of the Engineer for
26 resolution prior to installation.
- 27 D. All hardware and equipment is to be mounted between 18" and 79" above floor level. This is to afford easy
28 access and, in the case of the lower limit, prevent damage to the components. Positioning of hardware
29 should be reviewed and approved by the Engineer and Site Coordinator(s) prior to installation.
- 30 E. Equipment racks shall be equipped with cable management hardware as to allow an orderly and secure
31 routing of copper cabling to the modular patch panels. Additional Jumper Management panels may be
32 required pending installation of other cable types on the equipment rack.
- 33 F. Each rack shall be grounded to the Telecommunications Ground Bar (GND) using a #6 AWG (or larger)
34 insulated stranded copper conductor (GREEN jacket) directly or via an adjacent grounded equipment rack.
35 Refer to grounding requirements below.

36 **3.2 LADDER RACK**

- 37 A. Provide support for ladder rack on 4ft. centers.

- 1 B. Maintain a 1.5 safety factor on all load limits specified herein.
- 2 C. Ladder rack support shall be by 5/8" diameter threaded rod when ceiling mounted. Ladder rack requiring
3 wall mounting shall utilize accessories supplied by the ladder rack manufacturer specifically for the purpose
4 of wall mounting ladder rack.
- 5 **3.3 D-RINGS**
- 6 A. Provide D-rings for cable routing and management in all areas where open cabling is routed along the wall
7 in an Equipment Room.
- 8 B. Locate D-rings on 24" centers vertically and horizontally.
- 9 C. Securely attach D-rings to the wall as required by the manufacturer.
- 10 **3.4 GROUNDING**
- 11 A. Provide a complete grounding system in accordance with the requirements of Section 27 05 26.
- 12 **3.5 CONDUITS AND CABLE ROUTING**
- 13 A. Refer to Section 26 05 33 for additional requirements.
- 14 B. Where conduits enter a telecommunications room, conduits shall be terminated on the wall where shown
15 on the contract documents. Conduits entering the room from the floor shall extend 3" above the floor slab
16 or 3" into the room below the raised floor.
- 17 C. Where cabling rises vertically in a telecommunications rooms, provide vertical cable management to
18 support the cabling from floor to ceiling level.
- 19 D. All conduits shall be reamed and shall be installed with a nylon bushing.
- 20 E. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of 2" or less,
21 maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter
22 greater than 2", maintain a bend radius of at least 10 times the internal diameter.

23 **END OF SECTION**

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**SECTION 27 13 00
BACKBONE CABLING REQUIREMENTS**

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing backbone communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of optical fiber and/or copper cabling.

1.2 RELATED WORK

- A. Section 27 05 00 – Basic Technology Systems Requirements.
B. Section 27 15 00 - Horizontal Cabling Requirements.
C. Section 27 17 20 - Support and Warranty.

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. 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** The basis of design is listed herein. Refer to Section **27 17 20** for additional acceptable manufacturers.

2.2 OPTICAL FIBER BACKBONE – OUTSIDE PLANT

- A. Direct Buried (Singlemode):
1. This optical fiber cable shall be suitable for direct burial.
 2. Optical fiber cable shall incorporate a corrugated steel armor tape to provide for resistance to rodent attack and all other optical fiber cable materials shall be all dielectric (no conductive materials).
 3. Optical fiber cable shall be filled with a water-blocking compound.
 4. Outer Sheath: Polyethylene (PE). The outer sheath shall be marked with the manufacturer's name, words identifying the cable type (e.g. "Optical Fiber Cable" or "Fiber Optic Cable"), year of manufacture, and sequential length markings. The actual length of the optical fiber cable shall be within -0/+1% of the length markings. The marking shall be in a contrasting color to the optical fiber cable jacket.
 5. Temperature Range:
 - a. Storage: -40°C to +70°C (no irreversible change in attenuation).
 - b. Operating: -40°C to +70°C.

- 1 6. Humidity Range: 0% to 100%.
- 2 7. Maximum Tensile Strength:
- 3 a. During Installation: 2700 Newton (600 lb. force) (no irreversible change in attenuation).
- 4 b. Long Term: 890 N (200 lb. force).
- 5 8. Bending Radius:
- 6 a. During Installation: 20 times cable diameter.
- 7 b. No Load: 10 times cable diameter.
- 8 B. Duct Bank (Singlemode):
- 9 1. This optical fiber cable shall be suitable for installation in underground duct and in innerduct.
- 10 2. Optical fiber cable materials shall be all dielectric (no conductive materials).
- 11 3. Optical fiber cable shall be filled with a water-blocking material.
- 12 4. Outer Sheath: Polyethylene (PE). The outer sheath shall be marked with the manufacturer's name,
- 13 words identifying the cable type (e.g., "Optical Fiber Cable" or "Fiber Optic Cable"), year of
- 14 manufacture, and sequential length markings. The actual length of the optical fiber cable shall be
- 15 within -0/+1% of the length markings. The marking shall be in a contrasting color to the cable jacket.
- 16 5. Temperature Range:
- 17 a. Storage: -40°C to +70°C (no irreversible change in attenuation).
- 18 b. Operating: -40°C to +70°C.
- 19 6. Humidity Range: 0% to 100%.
- 20 7. Maximum Tensile Strength:
- 21 a. During Installation: 2700 Newton (600 lb. force) (no irreversible change in attenuation).
- 22 b. Long Term: 890 N (200 lb. force).
- 23 8. Bending Radius:
- 24 a. During Installation: 20 times cable diameter.
- 25 b. No Load: 10 times cable diameter.
- 26 C. Basis of Design (Singlemode):
- 27 1. Corning (FREEDM).
- 28 **2.3 OPTICAL FIBER BACKBONE PERFORMANCE**
- 29 A. Singlemode (SM):
- 30 1. Fiber Type: Singlemode; doped silica core surrounded by a concentric glass cladding.
- 31 2. Core Diameter: 8 to 9 µm. All optical fibers shall be of the same nominal core diameter and profile.
- 32 3. Cladding Diameter: 125 ± 1.0µm.
- 33 4. Cladding Non-circularity: ≤ 1%.

- 1 5. Core to Cladding Offset: $\leq 0.8 \mu\text{m}$.
- 2 6. Fiber Coating Diameter:
- 3 a. $245 \pm 15\mu\text{m}$ (primary coating).
- 4 b. 900-nm (nominal) secondary coating (tight buffer).
- 5 c. All coatings shall be mechanically strippable without damaging the optical fiber.
- 6 7. Cut-off Wavelength (cabled fiber; $\lambda_{\text{cct}} \leq 1260\text{-nm}$.
- 7 8. Mode Field Diameter: 8.3 to $9.8 \mu\text{m}$ at 1300-nm ; $10.5 \pm 1.0 \mu\text{m}$ at 1550-nm .
- 8 9. Zero Dispersion Wavelength (λ_0): $1301.5 \text{ nm} \leq \lambda_0 \leq 1321.5 \text{ nm}$.
- 9 10. Zero Dispersion Slope (S_0): $\leq 0.092 \text{ ps/nm}^2\text{*km}$.
- 10 11. Fiber Attenuation (maximum @ $23 \pm 5^\circ\text{C}$; Backbone):
- 11 a. @ 1300-nm : 2.0 dB/km
- 12 b. @ 1550-nm : 1.75 dB/km
- 13 When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on
- 14 Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in
- 15 attenuation over the rated temperature range of the optical fiber cable shall not exceed 0.05
- 16 dB/km at 1550-nm . The magnitude of the maximum attenuation change of each individual optical
- 17 fiber shall not be greater than 0.15 dB/km at 1550-nm .
- 18 12. Fiber Dispersion (maximum):
- 19 a. @ 1285 to 1330-nm : 3.2-ps/nm*km
- 20 b. @ 1550-nm : 18-ps/nm*km
- 21 13. No optical fiber shall show a point discontinuity greater than 0.1 dB at the specified wavelengths.
- 22 Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for
- 23 rejection of that optical fiber by the Owner.

24 **PART 3 - EXECUTION**

25 **3.1 CABLE INSTALLATION REQUIREMENTS**

- 26 A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber
- 27 that is required to accommodate termination requirements and is intended to provide for cable repair and/or
- 28 equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured
- 29 in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a
- 30 common enclosure.
- 31 B. A minimum of 5 meters (approximately 15 feet) of slack cable (each cable if applicable) shall be coiled and
- 32 secured at both ends located in the entrance room, Telecommunications Room or main equipment room, for
- 33 backbone and intra-building cable.
- 34 C. Where exposed, all backbone fiber optic cable shall be installed in protective inner duct. This includes areas
- 35 where the cable is routed in cable tray and where making a transition between paths (e.g., between conduit
- 36 and cable tray or into equipment racks). The inner duct should extend into the termination and/or storage
- 37 enclosure(s) at system endpoints.

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.

1 5. The structured cabling and connectivity may be provided by the same company. Alternately, ally
2 or partnerships between cabling manufacturers and connectivity manufacturers will be
3 acceptable. Ad-hoc cabling solutions in which the cabling manufacturer does not have a
4 relationship, agreement, or other means of support channel arranged with the connectivity
5 manufacturer will not be accepted.

6 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 7. The jacket color for CAT 6 cable shall be blue.

8 8. Basis of Design:

9 a. Hubbell Nextspeed CMP

10 B. CAT 6A Plenum Cable:

11 1. The horizontal cable requirements must be met, as well as the following channel requirements.

12 2. CAT 6A cable shall terminate on rack-mounted modular patch panels in their respective
13 communication equipment room as indicated on the drawings.

14 3. Cable shall exceed transmission requirements listed in ANSI/TIA/EIA-568-C.2. Performance tests
15 shall be conducted using swept frequency testing through 500 MHz for the channel. All numbers
16 given are for a 4-connection channel. Discrete frequency testing results at 500 MHz is not
17 acceptable.

18 4. Performance tests shall be conducted using swept frequency testing through 500 MHz for the
19 channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at
20 500 MHz is not acceptable.

21 5. Performance data shall be provided by third-party independent testing laboratories only. Testing
22 data shall be submitted on the third-party testing laboratory letterhead. Test data will only be
23 accepted if it displays testing as a channel. Electrical characteristics of the performance of the
24 cable itself will not satisfy this requirement.

25 6. The structured cabling and connectivity may be provided by the same company. For the purpose
26 of this specification that shall mean that the cabling and connectivity must be marketed, branded,
27 supported, warranted, and distributed by the same company. Specifically, ally or partnerships
28 between cabling manufacturers and connectivity manufacturers do not meet this requirement
29 unless otherwise listed in Section 27 17 20 as an acceptable manufacturer. Specifically, products
30 made by others through an OEM relationship are acceptable if the products are marketed,
31 branded, supported, warranted, and distributed by the same company.

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2 7. The 4-connector channel performance margins in the table below shall be guaranteed margins above ANSI/TIA/EIA-568-C.2:

Electrical Value (1 - 500 MHz)	Minimum Margin
Insertion Loss:	3%
NEXT:	2 dB
PS NEXT:	3 dB
PSA NEXT:	3dB
PSA NEXT (Average):	
ACR-F:	2 dB
PS ACR-F:	3 dB
PSA ACR-F:	3 dB
PSA ACR-F (Average):	3 dB
Return Loss:	2 dB

- 3 8. The jacket color for CAT 6A cable shall be WHITE for data applications.

- 4 9. Basis of Design:

- 5 a. Hubbell C6AS

- 6 C. Refer to Section 27 17 20 for additional acceptable manufacturers.

7 **2.2 FACEPLATES/JACKS**

- 8 A. CAT 6 Jacks:

- 9 1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45
10 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The
11 combined modular jack assembly is referred to as an information outlet.
- 12 2. The same orientation and positioning of modular jacks shall be utilized throughout the
13 installation. Prior to installation, the Contractor shall submit the proposed configuration for each
14 information outlet type for review by the Engineer.
- 15 3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom
16 of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
- 17 4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall
18 be configured as to allow for the addition of one (1) additional modular jack CAT 6 to be installed
19 to supplement each such modular jack as defined by this project. The installation of these
20 supplemental modular jacks is NOT part of this project.
- 21 5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a
22 removable blank inserted into the opening.
- 23 6. All modular jacks will be fitted with a dust cover. Modular jacks shall incorporate a dust cover that
24 fits over and/or into the modular jack opening. The dust cover shall be designed to remain with
25 the modular jack assembly when the modular jack is in use. No damage to the modular jack
26 pinning shall result from insertion or removal of these covers. Dust covers that result in
27 deformation of the modular jack pinning, will not be accepted.
- 28 7. The information outlet faceplate shall be constructed of high impact plastic (except where noted
29 otherwise). The information outlet faceplate color shall (1) match the faceplate color used for
30 other utilities in the building or (2) when installed in surface raceway (if applicable), match the
31 color of that raceway.

- 1 8. All information outlets and the associated modular jacks shall be of the same manufacturer
2 throughout the project.
- 3 9. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.
- 4 10. The interface between the modular jack and the horizontal cable shall be a 110-type termination
5 block or insulation displacement type contact. Termination components shall be designed to
6 maintain the horizontal cable's pair twists as closely as possible to the point of mechanical
7 termination.
- 8 11. CAT 6 modular jacks shall be pinned per TIA-568B.
- 9 12. CAT 6 termination hardware shall, as a minimum, meet all of the mechanical and electrical
10 performance requirements of the following standards:
- 11 a. ANSI/TIA/EIA-568-A-5
12 b. ANSI/TIA/EIA-568A
13 c. ISO/IEC 11801
14 d. IEC 603-7
15 e. FCC PART 68 SUBPART F
- 16 13. The color for CAT 6 jacks shall be confirmed with Architect and Owner prior to ordering materials.
- 17 B. Cat 6A Jacks:
- 18 1. CAT 6A horizontal cable shall each be terminated at its designated work area location on RJ-45
19 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The
20 combined modular jack assembly is referred to as an information outlet.
- 21 2. The same orientation and positioning of modular jacks shall be utilized throughout the
22 installation. Prior to installation, the Contractor shall submit the proposed configuration for each
23 information outlet type for review by the Architect/Engineer.
- 24 3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom
25 of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
- 26 4. Where standalone CAT 6A only modular jacks are identified, the information outlet faceplate shall
27 be configured as to allow for the addition of one (1) additional modular jack (CAT 3, CAT 5E, or
28 CAT 6) to be installed to supplement each such modular jack as defined by this project. The
29 installation of these supplemental modular jacks is NOT part of this project.
- 30 5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a
31 removable blank inserted into the opening.
- 32 6. The information outlet faceplate shall be constructed of high impact plastic (except where noted
33 otherwise). The information outlet faceplate color shall:
- 34 a. Match the faceplate color used for other utilities in the building, or
35 b. When installed in surface raceway (if applicable), match the color of that raceway.
- 36 7. Different faceplate and frame designs for locations, which include optical fiber cabling relative to
37 those, that terminate only copper cabling are acceptable. Information outlets that incorporate
38 optical fiber shall be compliant with the above requirements plus:
- 39 a. Be a low-profile assembly.
40 b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.

- 1 c. Position the optical fiber couplings to face downward or at a downward angle to
2 prevent contamination.
- 3 d. Incorporate a shroud that protects the optical fiber couplings from impact damage.
- 4 8. All information outlets and the associated modular jacks shall be of the same manufacturer
5 throughout the project.
- 6 9. The CAT 6A modular jacks shall be non-keyed 8-pin modular jacks.
- 7 10. The interface between the modular jack and the horizontal cable shall be an angled insulation
8 displacement type contact and shall provide separation for ANEXT suppression. Termination
9 components shall be designed to maintain the horizontal cable's pair twists as closely as possible
10 to the point of mechanical termination.
- 11 11. CAT 6A modular jacks shall be pinned per TIA-568B.
- 12 12. CAT 6A termination hardware shall, as a minimum, meet all the mechanical and electrical
13 performance requirements of the following standards:
- 14 a. ANSI/TIA/EIA-568-B.2-10
15 b. IEEE 802.af (PoE)
16 c. IEEE 802.an 10GBASE-T
17 d. ISO/IEC 60603-7
18 e. ISO 11801 Class E Compliant
19 f. FCC PART 68.5 SUBPART F
- 20 13. The color for CAT 6A jacks shall be WHITE for data applications. Alternately, a color-coded bezel or
21 icon may be used to identify the CAT 6A modular jack.

22 **PART 3 - EXECUTION**

23 **3.1 CABLE INSTALLATION REQUIREMENTS**

- 24 A. Horizontal Cabling:
- 25 1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet (90 meters) in
26 order to meet data communications performance specifications. This length is measured from the
27 termination panel in the wiring closet to the outlet and must include any slack required for the
28 installation and termination. The Contractor is responsible for installing horizontal cabling in a
29 fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above
30 constraints should be identified and reported to the Engineer prior to installation. Changes to the
31 contract documents shall be approved by the Engineer.
- 32 2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress,
33 Kellum grips may be used to spread the strain over a longer length of cable.
- 34 3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
- 35 4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between
36 supports. Refer to the specifications for required cable supports.
- 37 5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10'
38 intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.
- 39 6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.

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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.
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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.
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9. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:
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- 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.
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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, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone.
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- B. Horizontal Cabling in Modular Furniture:
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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.
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2. Where modular furniture is installed without wall contact, the Contractor shall install cabling through floor/ceiling fittings as shown on the drawings.
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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%.
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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.
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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.
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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.

1 **3.2 CABLE TERMINATION REQUIREMENTS**

2 A. Cable Terminations - Data UTP:

3 1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal
4 cabling to be terminated on the panel without disruption to existing connections.

5 2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be
6 provided for future use.

7 3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in
8 each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable
9 jacket shall be removed only to the extent required to make the termination.

10 **END OF SECTION**

**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.

- 1 7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the
2 specification defined herein, that cable and the associated termination(s) shall be replaced at the
3 expense of the Contractor. The applicable tests shall then be repeated.
- 4 8. Should it be found by the Engineer that the materials or any portion thereof furnished and
5 installed under this Contract fail to comply with the specifications and drawings, with respect or
6 regard to the quality, amount or value of materials, appliances or labor used in the work, it shall
7 be rejected and replaced by the Contractor and all work disturbed by changes necessitated in
8 consequence of said defects or imperfections shall be made good at the Contractor's expense.
- 9 a. CAT 6 Cable:
- 10 1) Testing shall be from the modular jack at the information outlet to the
11 modular patch panel in the communication equipment room.
- 12 2) Horizontal cable shall be free of shorts within the pairs, and be verified for
13 continuity, pair validity and polarity, and conductor position on the modular
14 jack (e.g., wire map). Any defective, split or mis-positioned pairs must be
15 identified and corrected.
- 16 3) CAT 6 horizontal cable shall also be tested to 250 MHz as defined by TIA/EIA-
17 568-C.2. Measurements shall be of the "Basic Link" including cabling and
18 modular jacks at the information outlet and modular patch panel. Parameters
19 to be tested must include:
- 20 a) Wire Map
21 b) Length
22 c) NEXT Loss (Pair-to-Pair)
23 d) NEXT (Power Sum)
24 e) ELFEXT (Pair-to-Pair)
25 f) ELFEXT (Power Sum)
26 g) Return Loss
27 h) Attenuation
28 i) Propagation Delay
29 j) Delay Skew
- 30 4) The maximum length of horizontal cable shall not exceed 295 feet (90m),
31 which allows 33 feet (10 m) for technology equipment and modular patch
32 cords.
- 33 5) To establish testing baselines, cable samples of known length and of the cable
34 type and lot installed shall be tested. The cable may be terminated with an
35 eight-position CAT 6 modular connector (8-pin) to facilitate testing. Net
36 Propagation Velocity (NPV) and nominal attenuation values shall be calculated
37 based on this test and be utilized during the testing of the installed cable
38 plant. This requirement can be waived if NPV data is available from the cable
39 manufacturer for the exact cable type under test.
- 40 6) CAT 6 horizontal cable testing shall be performed using a test instrument
41 designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on
42 each cable and display the specified parameters, comparing test values with
43 standards based "templates" integral to the unit. Field testers that report a
44 PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.
- 45 7) In the event results of the tests are not satisfactory, the Contractor shall make
46 adjustments, replacement and changes as necessary and shall then repeat the
47 test or tests that disclosed faulty or defective material, equipment or
48 installation method, and shall make additional tests as the Engineer deems
49 necessary at no additional expense to the project or user agency.

- 1 2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of
2 testing shall be approved by the Architect/Engineer.
- 3 3. Visually inspect all optical fiber cabling and termination points to ensure that they are complete
4 and conform to the standards defined herein. Provide the Architect/Engineer with a written
5 certification that this inspection has been made.
- 6 4. Conduct acceptance testing according to a schedule coordinated with the
7 Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the
8 test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer
9 to allow for such participation. The notification shall include a written description of the proposed
10 conduct of the tests, including copies of blank test result sheets to be used.
- 11 5. Tests related to connected equipment of others shall only be done with the permission and
12 presence of the Contractor involved. The Contractor shall ascertain that testing only is required to
13 prove that the optical fiber connections are correct.
- 14 6. Provide test results and describe the conduct of the tests including the date of the tests, the
15 equipment used and the procedures followed. At the request of the Architect/Engineer, provide
16 copies of the original test results.
- 17 7. All optical fiber cabling shall be 100% fault-free unless noted otherwise. If any optical fiber cable is
18 found to be outside the specification defined herein, that optical fiber cable and the associated
19 connector(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be
20 repeated.
- 21 8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished
22 and installed under this Contract fail to comply with the specifications and drawings with respect
23 or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it
24 shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in
25 consequence of said defects or imperfections shall be made good at the Contractor's expense.
- 26 9. The optical fibers utilized in the installed cable shall be traceable to the manufacturer. Upon
27 request by the Owner, provide cable manufacturer's test report for each reel of cable provided.
28 These test reports shall include manufacturer's on-reel attenuation test results at 850-nm and
29 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
- 30 a. On-the-reel bandwidth performance as tested at the factory. Factory data shall be
31 provided upon request.
- 32 b. The testing noted for optical fiber cabling utilizes an Optical Time Domain Reflectometer
33 (OTDR). However, the Contractor may submit to the Architect/Engineer for pre-approval
34 of alternate fiber optic testing equipment.
- 35 c. Tests Prior to Installation:
- 36 1) The Contractor, at their discretion and at no cost to the Owner, may perform
37 an attenuation test with an OTDR at 850-nm or 1300-nm on each optical fiber
38 of each cable reel prior to installation. Supply this test data to the
39 Architect/Engineer prior to installation.

1 that point shall be a valid basis for rejection of that optical
2 fiber by the Owner. The installation of that optical fiber
3 cable shall be reviewed in an effort to remove any external
4 stress that may be causing the fault. If such efforts do not
5 remove the fault, that optical fiber cable and the
6 associated terminations shall be replaced at the expense
7 of the Contractor.

8 **2.3 DOCUMENTATION/AS-BUILTS/RECORDS**

9 A. General:

- 10 1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of
11 Section 27 05 00 and Division 1. Documentation shall include the items detailed in the subsections
12 below.
- 13 2. All documentation, including hard copy and electronic forms shall become the property of the
14 Owner.
- 15 3. The Engineer may request that a 10% random field retest be conducted on the cable system at no
16 additional cost to verify documented findings. Tests shall be a repeat of those defined above. If
17 findings contradict the documentation submitted by the Contractor, additional testing can be
18 requested to the extent determined necessary by the Engineer, including a 100% retest. This
19 retest shall be at no additional cost to the Owner.

20 B. Copper Media Test Data:

- 21 1. Test results shall include a record of test frequencies, cable type, conductor pair and cable (or
22 Outlet) I.D., measurement direction, test equipment type, model and serial number, date,
23 reference setup, and crew member name(s).
- 24 2. Printouts generated for each cable by the wire test instrument shall be submitted as part of the
25 documentation package. The Contractor shall furnish this information in electronic form (CD-
26 ROM). The CD-ROM shall contain the electronic equivalent of the test results as defined by the bid
27 specification and be of a format readable by Microsoft Word (Version 6.0 or newer). The
28 Contractor shall provide a licensed copy of the software required to view and print the data that is
29 provided in a proprietary format. The Contractor shall furnish one (1) copy of the Data and
30 Display (if applicable) software.

31 C. Record Drawings:

- 32 1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified
33 by their sequential number as defined elsewhere in this document. Numbering, icons and drawing
34 conventions used shall be consistent throughout all documentation provided.

35 **PART 3 - EXECUTION**

36 NOT APPLICABLE

37 **END OF SECTION**

1
2
SECTION 27 17 20
SUPPORT AND WARRANTY

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. This section describes support and warranty requirements relating to the structured cabling system and
6 related subsystems.

7 **1.2 RELATED SECTIONS**

- 8 A. Section 27 05 00 – Basic Technology Systems Requirements.

9 **1.3 QUALITY ASSURANCE**

- 10 A. Refer to Section 27 05 00 for relevant standards.

11 **PART 2 - PRODUCTS**

12 **2.1 MANUFACTURER REQUIREMENTS**

- 13 A. The Basis of Design for all structured cabling components is listed in the individual Division 27 sections.
14 Alternative acceptable manufacturers will not be accepted for this project.

15 **2.2 WARRANTY**

- 16 A. A twenty-five (25) year Product Installation Warranty and System Assurance Warranty shall be provided for
17 the structured cabling system as described in the contract documents.
- 18 B. The Product Installation Warranty shall cover the replacement or repair of the defective product(s) and
19 labor for the replacement or repair of such defective product(s).
- 20 C. The system assurance warranty shall cover the failure of the wiring system to support the application it was
21 designed to support, as well as additional applications introduced in the future by recognized standards or
22 user forums that use the TIA/EIA 568A component and link/channel specifications for cabling.
- 23 D. Upon successful completion of the installation and subsequent inspection, the Owner shall be provided with
24 a numbered certificate from the manufacturing company registering the installation.

25 **PART 3 - EXECUTION**

26 NOT APPLICABLE

27 **END OF SECTION**

SECTION 27 21 33
WIRELESS ACCESS POINTS (WAP)

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PART 1 – GENERAL

1.1. SCOPE

- 19 A. The work under this section is for the installation of OWNER PROVIDED, CONTRACTOR INSTALLED Wireless
20 Access Points (WAP).
21 B. The WAPs shall be installed by the contractor providing and installing the Communications Cable and Equipment.
22 All contractor qualifications and certifications for that section shall apply to this section.
23

1.2. RELATED SPECIFICATIONS

- 25 A. The Contractor shall be responsible for reviewing all other specifications for requirements associated with the
26 complete installation of WAP's. This includes but is not limited to the following:
27 1. 01 31 23 Project Management Web Site
28 2. 01 33 23 Submittals
29 3. 27 00 05 Communications Cable and Equipment
30

1.3. SUBMITTALS

- 32 A. Contractor licenses and qualifications are required as part of the complete Division 27 submittal package as
33 indicated under Specification 27 00 05.
34 B. No submittals are required for the owner provided WAP.
35 C. Submittals are required for installation/hanger equipment, connectors, and any other required
36 equipment/material required for a complete WAP installation.
37

PART 2 - PRODUCTS

2.1. WIRELESS ACCESS POINT (WAP) DEVICES

- 41 A. The City of Madison Information Technology Department (CoM-IT) will be providing the WAP devices for this
42 project.
43 B. The WAP device being used will be as manufactured by the Cisco, Model 3700E and shall be used for all types of
44 ceiling mounted installations (suspended, gyp board, open truss, etc).
45

PART 3 - EXECUTION

3.1. OWNER RESPONSIBILITIES

- 49 A. The CoM-IT shall be responsible for ordering, making payment (including shipping fees), and configuring all WAP
50 devices in a timely manner to comply with the Contractors schedule.
51 B. The CoM-IT shall configure and test each WAP to CoM-IT specifications prior to providing them to the contractor
52 for installation.
53 C. The CoM-IT shall number each WAP and provide the contractor with a location map indicating where each WAP
54 will be installed.
55 C. The CoM-IT shall test all WAP's after installation to verify configuration and signaling is correct prior to accepting
56 the final installation of the WAP system.
57

- 1 **3.2. CONTRACTORS RESPONSIBILITIES**
2 A. The Contractor shall be solely responsible for coordinating with CoM-IT the scheduling and receipt of all WAP
3 devices with his/her installation schedule.
4 B. The Contractor shall inspect all WAP devices upon receipt for damage. CoM-IT shall be notified immediately of
5 any damage.
6 C. The Contractor shall provide all mounting hardware, blocking, and other items required for a complete
7 installation to the manufacturers installation requirements.
8 D. The Contractor shall install all WAP devices per plans and specifications including cable connections.
9 E. The Contractor shall be responsible to pick up WAP devices from City IT and delivery to the jobsite.

- 10
11 **3.3. FINAL TESTING**
12 A. Contractor shall provide final testing of all WAP devices after installation is complete.
13 B. In the event any WAP device is not operating properly the contractor shall trouble shoot the installation and
14 work with the CoM-IT to determine if re-configuration of the device will be required.
15 C. The CoM-IT shall be responsible for reconfiguring WAP's as needed after installation is complete. The contractor
16 shall be responsible for verifying connections, cabling and connectivity of the installation is correct.
17

- 18 **3.4. WARRANTY**
19 A. The CoM-IT will be responsible for registering any warranty information associated with the purchase and
20 ownership of all WAP devices.
21 B. The Contractor shall warrant the installation of the WAP device for one (1) year per the terms of this contract.
22
23

END OF SECTION

SECTION 27 41 23
AUDIO-VIDEO ACCESSORIES

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20

PART 1 – GENERAL

1.1. SUMMARY

- 24 A. This specification shall identify equipment components and accessories required to complete Audio-Video (A/V)
25 installations not previously identified in other Division 27 specifications. It does not include materials such as
26 cables, boxes, connectors, conduit, supports and other ancillary equipment required to complete the installation.
27 B. This specification shall clearly identify responsibilities of various contractors and the Owner including project
28 coordination, installation, and testing of installed components.
29 C. For the purposes of this specification the term Contractor shall refer to the person(s) responsible for installing
30 and integrating the A/V components and equipment described herein, and may or may not be the same
31 contractor installing other Division 27 and 28 related equipment. Other contractors having related work shall be
32 referred to by full title (Electrical Contractor).
33

1.2. RELATED SPECIFICATIONS

- 34 A. 01 31 23 Project Management Web Site
35 B. 01 33 23 Submittals
36 C. 01 78 23 Operation and Maintenance Data
37 D. 01 78 36 Warranties
38 E. 01 78 39 As-Built drawings
39 F. All Division 27 specifications that may apply to this installation
40 G. Other division specifications that may apply to this work for coordination
41
42

1.3. AREAS OF RESPONSIBILITY

- 43 A. The General Contractor shall be responsible for ensuring all of the following:
44 1. Coordinate with the Contractor and the Owner or Owners Representative the scheduling, purchasing,
45 and receiving of all Owner provided products and equipment.
46 2. Coordinate all Contractor related work with the construction schedule.
47 3. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and
48 resolve installation issues as needed.
49 B. The Contractor shall be responsible for all of the following:
50 1. Direct coordination with the Owner or Owners Representatives for all equipment being provided and/or
51 configured by the Owner.
52 2. Verification of Owner installation requirements prior to installing equipment and accessories.
53 C. The Owner or Owners Representatives shall be responsible for all of the following:
54 1. Coordinating all purchases and deliveries of the Owner provided equipment to the project site with the
55 GC and Contractor so as not to delay the installation or project schedule.
56 2. Coordinate the pre-installation configuration of any A/V equipment so as not to delay the installation or
57 project schedule.
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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 contractor 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 Contractor 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 Contractor 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.

- 1 D. Wall mount brackets for monitors shall meet the following requirements regardless of size:
2 1. Black powder coat finish
3 2. Minimum vertical tilt +15/-5 degrees
4 3. Thin profile to minimize wall clearance when installation is complete
5 4. All monitors shall have fully articulating arms with a minimum 18" horizontal extension to provide a wide
6 range of motion and/or to facilitate the removal of the monitor without having to remove adjacent
7 monitors.
8 5. Models as manufactured by:
9 a. Peerless-AV
10 b. Chief Manufacturing
11 c. Omnimount
12 d. Premier Mounts
13 e. Video Mount Products
14 f. No other substitutions will be allowed
15

16 2.5. IP CABLE BOX

- 17 A. IP Cable Boxes shall be provided by the Owner and installed by the Contractor. This section is being provided as
18 informational only. The Contractor shall be responsible for providing/installing the input to the cable box and
19 the output to the monitor.
20 1. Amino Communications, Aminet A140, cable box
21 a. Input = Ethernet 10/100 BaseT via RJ-45 shielded connector
22 b. Output = HDMI 1.3A with HDCP
23 c. Power = 120V
24 d. Decodes up to 720p and 1080i; displays up to 1080p
25 e. HD graphics up to 1280x720
26 B. The Owner shall designate which model is required at each location.
27

28 2.6 SPEAKERS

- 29 A. The contractor shall provide the following speakers or those of similar quality.
30 1. Similar to Bogen Model: S810T725PG8WVR. 70 volt, 4 watt, ceiling mounted. Provide speaker and all
31 mounting hardware to make for a complete installation.
32 2. Similar to Bogen WBS810T725, 70 volt, 4 watt, wall mount. Provide speaker and all mounting hardware
33 to make for a complete installation.
34

35 2.7 POWER AMPLIFIER

- 36 A. The contractor shall provide the following system or those of similar quality.
37 1. Crestron Audio Video system will be rack mounted and coordinated further with the City of Madison IT
38 Department for this project. Coordinate mounting on site in each room with owner and architect. Can
39 mount behind monitor but must be accessible.
40

41 PART 3 - EXECUTION

42 3.1. CONTRACTOR COORDINATION

- 43 A. The Contractor shall coordinate with the General Contractor (GC) and all other trade contractors as needed for
44 the installation of the A/V Accessories. Coordination shall include a pre-installation meeting during rough-in to
45 ensure blocking, power outlets, and data outlets are properly located.
46 B. The Contractor shall review all plans and specifications indicating wall and position requirements for accessory
47 A/V equipment and install all required equipment accordingly.
48 1. The Contractor shall coordinate all connection and installation requirements with other trade contractors
49 doing Division 27 Work.
50
51

52 3.2. GENERAL INSTALLATION REQUIREMENTS

- 53 A. Cables/cords shall be properly plugged in. Excess cable/cord shall be neatly looped and bundled using Velcro
54 cable ties. Zip ties, wire ties, and other rigid, semi-permanent restraints will not be allowed.
55 1. Excess cables/cords shall not be visible after the installation is complete.
56 a. Example: Cables/cords behind wall monitors shall be neatly bundled behind the monitor and
57 fastened to the monitor wall mount so as not to be visible from the front of the monitor.

- 1 B. Equipment mounts shall be properly sized for the equipment being supported. Fasteners shall be of sufficient
2 strength to support the finished installation including required equipment.
3 1. Fasteners shall be firmly attached to blocking where provided.
4 2. Fasteners in solid materials such as concrete, brick, etc shall use appropriate sleeves and anchors for the
5 material, weight being supported, and fastener being used.
6 3. All drop ceiling mount locations shall have tile bridge supports.
7 C. Final testing of A/V components shall be performed only after all A/V equipment and components within
8 Division 27 have been completely installed to ensure all components have been properly integrated with each
9 other as needed.
10

11 **3.2. EQUIPMENT INSTALLATION, TESTING, AND ACCEPTANCE**

- 12 A. Any required system programming (by CoM-IT or Contractor) shall be completed prior to doing any installation
13 testing and acceptance.
14 B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of
15 completing the installation to coordinate all final testing of the completed system.
16 C. Wall Mounts:
17 1. Wall mounts shall be securely fastened to the wall and blocking per the manufacturer's supplied
18 instructions and mounting hardware. Wall mounts shall be located horizontally and vertically on the
19 designated wall as indicated in plans and details for each room receiving monitors.
20 2. Monitors shall be securely installed on the wall mount.
21 3. The mounting bracket shall be tested with the completed monitor and cable/cords properly installed.
22 The completed installation and successful testing of the mounting bracket installation shall provide the
23 following:
24 a. All cords/cables are properly plugged in, excessive cable is bundled but not stretched tight,
25 cords/cables are not pinched or impede the mounting brackets range of motion.
26 b. Full range of motion in all directions as per the specifications above.
27 D. Monitor testing shall be part of the overall Division 27 installation of all A/V equipment and requirements. This
28 shall include but not be limited to the following:
29 1. Remote control is fully functional at each monitor location
30 a. A single remote is used and properly programmed to control monitors, IPTV cable boxes and
31 other devices as needed.
32 i. Controls on/off/volume and other related functions as a TV with an IP Cable Box.
33 ii. Controls various input modes as a monitor as described in other Division 27 specifications.
34 iii. Works with other video/audio feeds as described in other Division 27 specifications.
35 2. Monitor (each location) functions in all modes and inputs as designated in the contract documents.
36 a. Test with Polycom system
37 b. Test with portable devices (laptop, etc)
38 E. The IP Cable Box shall be tested at each location installed. Testing shall include verifying all intended functions
39 perform as expected. Troubleshoot and re-test as necessary. Contact Owners Representative if a bad unit is
40 suspected for immediate replacement.
41 F. A completed and accepted installation shall pass all of the above tests for each location where equipment will be
42 installed.
43 G. The warranty period for the completed and accepted installation shall not begin until the date of the accepted
44 general contract. The Contractor shall coordinate this date with the General Contractor.
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END OF SECTION

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**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. Low Voltage Security 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 of fire-rated construction as described in Division 7.

1.3 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. Successful Bidders shall itemize all work and list associated hours and pay scale for each item.

1.4 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:
 - 1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.

- 1 2. “Electrical Contractor” shall also refer to the Contractor listed in Division 28 of this specification
2 when the “Suggested Matrix of Scope Responsibility” indicates the work shall be provided by the
3 EC. Refer to the Contract Documents for the “Suggested Matrix of Scope Responsibility”.
- 4 3. “Security Contractor” as referred to herein refers to the Contractors listed in Division 28 of this
5 Specification.
- 6 4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems,
7 used for analog and/or digital signals between equipment.
- 8 C. General:
- 9 1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work
10 responsibilities as related to Security Systems including conduit, cable tray, power wiring and Low
11 Voltage Security Wiring. The prime contractor is responsible for all divisions of work.
- 12 2. The exact wiring requirements for much of the equipment cannot be determined until the systems
13 have been purchased and submittals are approved. Therefore, only known wiring, conduits,
14 raceways, and electrical power as related to such items, is shown on the Security Drawings. Other
15 wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security
16 Drawings but required for the successful operation of the systems shall be the responsibility of the
17 Security Contractor and included in the Contractor's bid.
- 18 3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power
19 connections in support of Security systems, the final installation shall not begin until a coordination
20 meeting between the Electrical Contractor and the Security Contractor has convened to determine
21 the exact location and requirements of the installation.
- 22 4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage
23 Security Wiring, the installation shall not begin until the Security Contractor has completed a
24 coordination review of the cable tray shop drawing.
- 25 5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and
26 installation. The Security Contractor shall cooperate with the Electrical Contractor and the
27 determined elevations in accordance with the guidelines below. This Contractor shall coordinate
28 utility elevations with other trades. When a conflict arises, priority shall be as follows:
- 29 a. Lighting Fixtures
30 b. Gravity Flow Piping, including Steam and Condensate
31 c. Sheet Metal
32 d. Electrical Busduct
33 e. Cable Trays, including 12” access space
34 f. Sprinkler Piping and other Piping
35 g. Conduit and Wireway
36 h. Open Cabling
- 37 D. Electrical Contractor's Responsibility:
- 38 1. Assumes all responsibility for all required conduit and power connections when shown on the
39 “Suggested Matrix of Scope Responsibility” to be provided by the Electrical Contractor.
- 40 2. Assumes all responsibility for providing and installing cable tray.
- 41 3. Responsible for Security Systems grounding and bonding.
- 42 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
43 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
44 determine a viable layout.

- 1 E. Security Contractor's Responsibility:
- 2 1. Assumes all responsibility for the Low Voltage Security Wiring of all systems, including cable support
3 where open cable is specified.
- 4 2. Assumes all responsibility for all required backboxes, conduit and power connections not
5 specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope
6 Responsibility."
- 7 3. Responsible for providing the Electrical Contractor with the required grounding lugs or other
8 hardware for each piece of Security equipment which is required to be bonded to the
9 telecommunications ground system.
- 10 4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field
11 coordination conflicts are found, the Contractor shall coordinate with other Contractors to
12 determine a viable layout.

13 **1.5 COORDINATION DRAWINGS**

- 14 A. Definitions:
- 15 1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the
16 sizes and locations, including elevations, of system components and required access areas to ensure
17 that no two objects will occupy the same space.
- 18 a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork,
19 fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and
20 steam condensate piping, and any item that may impact coordination with other
21 disciplines.
- 22 b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5"
23 and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting,
24 ceiling-mounted devices, and any item that may impact coordination with other
25 disciplines.
- 26 c. Technology trades shall include, but are not limited to, technology equipment, racks,
27 conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway,
28 ceiling-mounted devices, and any item that may impact coordination with other
29 disciplines.
- 30 d. Maintenance clearances and code-required dedicated space shall be included.
- 31 e. The coordination drawings shall include all underground, underfloor, in-floor, in chase,
32 and vertical trade items.
- 33 2. The contractors shall use the coordination process to identify the proper sequence of installation
34 of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated
35 end result, and to provide adequate access for service and maintenance.
- 36 B. Participation:
- 37 1. The contractors and subcontractors responsible for work defined above shall participate in the
38 coordination drawing process.
- 39 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a
40 complete set of composite electronic CAD coordination drawings that include all applicable trades,
41 and for coordinating the activities related to this process. The Coordinating Contractor for this
42 project shall be the Mechanical Contractor.

- 1 a. The Coordinating Contractor shall utilize personnel familiar with requirements of this
2 project and skilled as draftspersons/CAD operators, competent to prepare the required
3 coordination drawings.
- 4 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by
5 other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if
6 the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will
7 not consider blatant reproductions of original file copies an acceptable alternative for coordination
8 drawings.
- 9 C. Drawing Requirements:
- 10 1. The file format and file naming convention shall be coordinated with and agreed to by all
11 contractors participating in the coordination process and the Owner.
- 12 a. Scale of drawings:
- 13 1) General plans: 1/4 Inch = 1'-0" (minimum).
- 14 2) Mechanical, electrical, communication rooms, and including the surrounding
15 areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
- 16 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
- 17 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1
18 '-0" (minimum).
- 19 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
- 20 2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout
21 drawings shall be modified to accommodate other components as the coordination process
22 progresses.
- 23 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and
24 shafts.
- 25 4. The minimum quantity of drawings will be established at the first coordination meeting and sent to
26 the A/E for review. Additional drawings may be required if other areas of congestion are discovered
27 during the coordination process.
- 28 D. General:
- 29 1. Coordination drawing files shall be made available to the A/E and Owner's Representative. The A/E
30 will only review identified conflicts and give an opinion, but will not perform as a coordinator.
- 31 2. A plotted set of coordination drawings shall be available at the project site.
- 32 3. Coordination drawings are not shop drawings and shall not be submitted as such.
- 33 4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for
34 each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material,
35 and labor to allow for adjustments in routing of utilities made necessary by the coordination process
36 and to provide a complete and functional system.
- 37 5. The contractors will not be allowed additional costs or time extensions due to participation in the
38 coordination process.

- 1 6. The contractors will not be allowed additional costs or time extensions for additional fittings, re-
2 routings or changes of duct size, that are essentially equivalent sizes to those shown on the
3 drawings and determined necessary through the coordination process.
- 4 7. The A/E reserves the right to determine space priority of equipment in the event of spatial conflicts
5 or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
- 6 8. Changes to the contract documents that are necessary for systems installation and coordination
7 shall be brought to the attention of the A/E.
- 8 9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated
9 on the drawings.
- 10 a. Access to mechanical, electrical, technology, and other items located above the ceiling
11 shall be through accessible lay-in ceiling tile areas.
- 12 b. Potential layout changes shall be made to avoid additional access panels.
- 13 c. Additional access panels shall not be allowed without written approval from the A/E at
14 the coordination drawing stage.
- 15 d. Providing additional access panels shall be considered after other alternatives are
16 reviewed and discarded by the A/E and the Owner's Representative.
- 17 e. When additional access panels are required, they shall be provided without additional
18 cost to the Owner.
- 19 10. Complete the coordination drawing process and obtain sign off of the drawings by all contractors
20 prior to installing any of the components.
- 21 11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the
22 contractor or subcontractor who did not properly identify their work requirements, or installed
23 their work without proper coordination.
- 24 12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

25 **1.6 QUALITY ASSURANCE**

- 26 A. Qualifications:
- 27 1. Only products of reputable manufacturers as determined by the Architect/Engineer will be
28 acceptable.
- 29 2. Each Contractor and their subcontractors shall employ only workers who are skilled in their
30 respective trades and fully trained. All workers involved in the installation, termination, testing,
31 and placing into operation electronic security devices shall be individually trained by the
32 manufacturer.
- 33 3. The Contractor shall be experienced in all aspects of this work and shall be required to demonstrate
34 direct experience on recent systems of similar type and size.
- 35 4. The Contractor shall own and maintain tools and equipment necessary for successful installation
36 and testing of electronic security devices and have personnel adequately trained in the use of such
37 tools and equipment.
- 38 5. A resume of qualification shall be submitted with the Contractor's bid indicating the following:

- 1 a. A list of recently completed projects of similar type and size with contact names and
2 telephone numbers for each.
- 3 B. Compliance with Codes, Laws, Ordinances:
- 4 1. This Contractor shall conform to all requirements of the City of Madison, Wisconsin Codes, Laws,
5 Ordinances and other regulations having jurisdiction over this installation.
- 6 2. In the event there are no local codes having jurisdiction over this job, the current issue of the
7 National Electrical Code shall be followed.
- 8 3. If there is a discrepancy between the codes and regulations having jurisdiction over this installation,
9 and these specifications, the codes and regulations shall determine the method or equipment used.
- 10 4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which
11 are not in accordance with the applicable codes or regulations, he shall inform the
12 Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this
13 procedure, he shall submit with the proposal, a separate price required to make the system shown
14 on the drawings comply with the codes and regulations.
- 15 5. All changes to the system made after the letting of the contract, in order to comply with the
16 applicable codes or the requirements of the Inspector, shall be made by the Contractor without
17 cost to the Owner.
- 18 C. Permits, Fees, Taxes, Inspections:
- 19 1. Procure all applicable permits and licenses.
- 20 2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political
21 Subdivision wherein the work is done, or as required by any duly constituted public authority.
- 22 3. Pay all applicable charges for such permits or licenses that may be required.
- 23 4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
- 24 5. Pay all charges arising out of required inspections due to codes, permits, licenses or as otherwise
25 may be required by an authorized body.
- 26 6. Pay all charges arising out of required contract document reviews associated with the project and
27 as initiated by the Owner or authorized independent agency/consultant.
- 28 7. All equipment, and materials shall be as approved or listed by the following: (Unless approval or
29 listing is not applicable to an item by all acceptable manufacturers.)
- 30 a. Factory Mutual
31 b. Underwriters' Laboratories, Inc.
- 32 D. Examination of Drawings:
- 33 1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the
34 work and to indicate the general arrangements and locations of equipment etc., and the
35 approximate sizes of equipment.
- 36 2. Contractor shall determine the exact locations of equipment and the exact routing of cabling so as
37 to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for
38 determining this layout. Where a specific route is required, such route will be indicated on the
39 drawings.

- 1 3. Where job conditions require reasonable changes in indicated arrangements and locations, such
2 changes shall be made by the Contractor at no additional cost to the Owner.
- 3 4. If an item is either shown on the drawings, called for in the specifications or required for proper
4 operation of the system, it shall be considered sufficient for including same in this contract.
- 5 5. The determination of quantities of material and equipment required shall be made by the
6 Contractor from the drawings. Schedules on the drawings and in the specifications are completed
7 as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
- 8 6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it
9 shall be taken to mean, to furnish, install and terminate completely ready for operation, the items
10 mentioned.

11 E. Electronic Media/Files:

- 12 1. Construction drawings for this project have been prepared utilizing Revit.
- 13 2. Contractors and Subcontractors may request electronic media files of the contract drawings and/or
14 copies of the specifications. Specifications will be provided in PDF format.
- 15 3. Upon request for electronic media, the Contractor shall complete and return a signed "Electronic
16 File Transmittal" form provided by IMEG.
- 17 4. If the information requested includes floor plans prepared by others, the Contractor will be
18 responsible for obtaining approval from the appropriate Design Professional for use of that part of
19 the document.
- 20 5. The electronic contract documents can be used for preparation of shop drawings and as-built
21 drawings only. The information may not be used in whole or in part for any other project.
- 22 6. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout
23 drawings or coordination drawings.
- 24 7. The use of these CAD documents by the Contractor does not relieve them from their responsibility
25 for coordination of work with other trades and verification of space available for the installation.
- 26 8. The information is provided to expedite the project and assist the Contractor with no guarantee by
27 IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility
28 or liability for the Contractor's use of these documents.

29 F. Field Measurements:

- 30 1. Before ordering any materials, this Contractor shall verify all pertinent dimensions at the job site
31 and be responsible for their accuracy.

32 **1.7 SUBMITTALS**

- 33 A. Submittals shall be required for the following items, and for additional items where required elsewhere in the
34 specifications or on the drawings.

- 35 1. Submittals list:

<u>Referenced Specification Section</u>	<u>Submittal Item</u>
28 13 00	Electronic Access Control
28 20 00	Electronic Surveillance

- 1 B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
- 2 1. Transmittal: Each transmittal shall include the following:
- 3 a. Date
- 4 b. Project title and number
- 5 c. Contractor's name and address
- 6 d. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 7 e. Description of items submitted and relevant specification number
- 8 f. Notations of deviations from the contract documents
- 9 g. Other pertinent data
- 10 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
- 11 a. Date
- 12 b. Project title and number
- 13 c. Architect/Engineer
- 14 d. Contractor and subcontractors' names and addresses
- 15 e. Supplier and manufacturer's names and addresses
- 16 f. Division of work (e.g., plumbing, heating, ventilating, etc.)
- 17 g. Description of item submitted (using project nomenclature) and relevant specification
- 18 number
- 19 h. Notations of deviations from the contract documents
- 20 i. Other pertinent data
- 21 j. Provide space for Contractor's review stamps
- 22 3. Composition:
- 23 a. Submittals shall be submitted using specification sections and the project nomenclature
- 24 for each item.
- 25 b. Individual submittal packages shall be prepared for items in each specification section. All
- 26 items within a single specification section shall be packaged together where possible. An
- 27 individual submittal may contain items from multiple specifications sections if the items
- 28 are intimately linked (e.g., pumps and motors).
- 29 c. All sets shall contain an index of the items enclosed with a general topic description on
- 30 the cover.
- 31 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings;
- 32 manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures;
- 33 performance and test data; wiring and control diagrams; dimensions; shipping and operating
- 34 weights; shipping splits; service clearances; and all other drawings and descriptive data of materials
- 35 of construction as may be required to show that the materials, equipment or systems and the
- 36 location thereof conform to the requirements of the contract documents.
- 37 5. Contractor's Approval Stamp:
- 38 a. The Contractor shall thoroughly review and approve all shop drawings before submitting
- 39 them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal
- 40 certifying it has been reviewed.
- 41 b. Unstamped submittals will be rejected.
- 42 c. The Contractor's review shall include, but not be limited to, verification of the following:
- 43 1) Only approved manufacturers are used.
- 44 2) Addenda items have been incorporated.

- 1 3) Catalog numbers and options match those specified.
2 4) Performance data matches that specified.
3 5) Electrical characteristics and loads match those specified.
4 6) Equipment connection locations, sizes, capacities, etc. have been coordinated
5 with other affected trades.
6 7) Dimensions and service clearances are suitable for the intended location.
7 8) Equipment dimensions are coordinated with support steel, housekeeping pads,
8 openings, etc.
9 9) Constructability issues are resolved (e.g., weights and dimensions are suitable
10 for getting the item into the building and into place, sinks fit into countertops,
11 etc.).
- 12 d. The Contractor shall review, stamp and approve all subcontractors' submittals as
13 described above.
- 14 e. **The Contractor's approval stamp is required on all submittals. Approval will indicate the**
15 **Contractor's review of all material and a complete understanding of exactly what is to**
16 **be furnished. Contractor shall clearly mark all deviations from the contract documents**
17 **on all submittals. If deviations are not marked by the Contractor, then the item shall be**
18 **required to meet all drawing and specification requirements.**
- 19 6. Submittal Identification and Markings:
- 20 a. The Contractor shall clearly mark each item with the same nomenclature applied on the
21 drawings or in the specifications.
- 22 b. The Contractor shall clearly indicate the size, finish, material, etc.
- 23 c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall
24 clearly indicate exactly which item and which data is intended.
- 25 d. All marks and identifications on the submittals shall be unambiguous.
- 26 7. Schedule submittals to expedite the project. Coordinate submission of related items.
- 27 8. Identify variations from the contract documents and product or system limitations that may be
28 detrimental to the successful performance of the completed work.
- 29 9. Reproduction of contract documents alone is not acceptable for submittals.
- 30 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with
31 prior approval from the Architect/Engineer.
- 32 11. Submittals not required by the contract documents may be returned without review.
- 33 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for
34 each product. If the first submittal is incomplete or does not comply with the drawings and/or
35 specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to
36 recheck and handle the additional shop drawing submittals.
- 37 13. Submittals shall be reviewed and approved by the Architect/Engineer **before** releasing any
38 equipment for manufacture or shipment.
- 39 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in
40 submittals is not relieved by the Architect/Engineer's approval.

- 1 C. Electronic Submittal Procedures:
- 2 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer,
3 unless a web-based submittal program is used.
- 4 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
- 5 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper
6 originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission
7 restrictions on files; protected, locked, or secured documents will be rejected.
- 8 4. File Names: Electronic submittal file names shall include the relevant specification section number
9 followed by a description of the item submitted, as follows. Where possible, include the transmittal
10 as the first page of the PDF instead of using multiple electronic files.
- 11 a. Submittal file name: 28 XX XX.description.YYYYMMDD
12 b. Transmittal file name: 28 XX XX.description.YYYYMMDD
- 13 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be transmitted
14 via a pre-approved method.

15 **1.8 SCHEDULE OF VALUES**

- 16 A. The requirements herein are in addition to the provisions of Division 1.
- 17 B. Format:
- 18 1. Use AIA Document Continuation Sheets or another similar form approved by the Owner and
19 Architect/Engineer.
20 2. Submit in Excel format.
21 3. Support values given with substantiating data.
- 22 C. Preparation:
- 23 1. Itemize work required by each specification section and list all providers. All work provided by
24 subcontractors and major suppliers shall be listed on the Schedule of Values. List each
25 subcontractor and supplier by company name.
- 26 2. Break down all costs into:
- 27 a. Material: Delivered cost of product with taxes paid.
28 b. Labor: Labor cost, excluding overhead and profit.
- 29 D. Update Schedule of Values when:
- 30 1. Indicated by Architect/Engineer.
31 2. Change of subcontractor or supplier occurs.
32 3. Change of product or equipment occurs.

33 **1.9 CHANGE ORDERS**

- 34 A. Refer to Division 1 for Change Order Requests.
- 35 B. Change order work shall not proceed until authorized.

1 **1.10 EQUIPMENT SUPPLIERS' INSPECTION**

2 A. The following equipment shall not be placed in operation until a representative of the manufacturer has
3 inspected the installation and certified that the equipment is properly installed and that the equipment is
4 ready for operation:

5 1. Firestopping, including mechanical firestop systems.

6 **1.11 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE**

7 A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.

8 B. Store materials on the site so as to prevent damage.

9 C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

10 **1.12 WARRANTY**

11 A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual
12 specifications sections within Division 28 may require additional warranty requirements for specific
13 equipment or systems.

14 B. The warranty period for the entire installation described in this Division of the specifications shall commence
15 on the date of substantial completion unless a whole or partial system or any separate piece of equipment or
16 component is put into use for the benefit of any party other than the installing contractor with prior written
17 authorization. In this instance, the warranty period shall commence on the date when such whole system,
18 partial system or separate piece of equipment or component is placed in operation and accepted in writing
19 by the Owner or their representative.

20 C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment
21 found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of
22 correcting all damage resulting from such defects or nonconformance with contract documents exclusive of
23 repairs required as a result of improper maintenance or operation, or of normal wear as determined by the
24 Architect/Engineer.

25 **1.13 INSURANCE**

26 A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

27 **1.14 MATERIAL**

28 A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job
29 design and establishes the equipment quality required to be used in this contract.

30 B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall
31 ensure that all items submitted by these other manufacturers meets all requirements of the drawings and
32 specifications and fits in the allocated space. The Architect/Engineer shall make the final determination of
33 whether a product is equivalent.

34 C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the
35 services and duties imposed by the design and is of a quality equal to or better than the material, article or
36 equipment identified by the drawings and specifications may be used if approval is secured **in writing** from
37 the Architect/Engineer not later than ten (10) days prior to the bid opening date. The Contractor bears full
38 responsibility for the unnamed manufacturer's equipment adequately meeting the intent of design. The
39 Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all
40 costs incurred by other trades on the project as a result of changes necessary to accommodate the offered
41 material, equipment or installation method.

- 1 D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed
2 manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate
3 materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary
4 alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using
5 the offered material, article or equipment necessitating extra expense on This Contractor or on the part of
6 other Contractors whose work is affected.

7 **PART 2 - PRODUCTS**

8 **2.1 REFER TO INDIVIDUAL SECTIONS**

9 **PART 3 - EXECUTION**

10 **3.1 JOBSITE SAFETY**

- 11 A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or
12 his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other
13 entity of their obligations, duties and responsibilities including, but not limited to, construction means,
14 methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all
15 portions of the work of construction in accordance with the contract documents and any health or safety
16 precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no
17 authority to exercise any control over any construction contractor or other entity or their employees in
18 connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite
19 safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be
20 made additional insureds under the Contractor's general liability insurance policy.

21 **3.2 GENERAL INSTALLATION REQUIREMENTS**

- 22 A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit
23 requirements described within this Division shall be supplemental to the requirement described in Section
24 26 05 33. Should conflicts exist between the two Divisions the more stringent (more expensive material and
25 labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and
26 responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- 27 B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation
28 as specified.
- 29 C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing
30 conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work.
31 All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-
32 existing conditions, including final colors and finishes.
- 33 D. All cables and devices installed in damp or wet locations, including any underground or underslab location,
34 shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation
35 practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result
36 of being installed in a damp or wet location shall be replaced at the Contractor's expense.

37 **3.3 FIELD QUALITY CONTROL**

- 38 A. General:
- 39 1. Refer to specific Division 28 sections for further requirements.
- 40 2. The Contractor shall conduct all tests required and applicable to the work both during and after
41 construction of the work.

- 1 3. The necessary instruments and materials required to conduct or make the tests shall be supplied
2 by the Contractor who shall also supply competent personnel for making the tests who has been
3 schooled in the proper testing techniques.
- 4 4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such
5 adjustments, replacements and changes as are necessary and shall then repeat the test or tests
6 which disclose faulty or defective work or equipment, and shall make such additional tests as the
7 Architect/Engineer or code enforcing agency deems necessary.
- 8 B. Protection of cable from foreign materials:
- 9 1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign
10 material application or contact with any cable type. Foreign material is defined as any material that
11 would negatively impact the validity of the manufacturer's performance warranty. This includes,
12 but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other
13 surface chemical, liquid or compound that could come in contact with the cable, cable jacket or
14 cable termination components.
- 15 2. Application of foreign materials of any kind on any cable, cable jacket or cable termination
16 component will not be accepted. It shall be the Contractor's responsibility to replace any
17 component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the
18 cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test
19 results of the cable containing overspray. Should the manufacturer and warrantor of the structured
20 cabling system desire to physically inspect the installed condition and certify the validity of the
21 structured cabling system (via a signed and dated statement by an authorized representative of the
22 structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said
23 warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition
24 to the statement from the manufacturer, the Contractor shall also present to the Owner a letter
25 from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable
26 to be intact and acceptable.
- 27 **3.4 PROJECT CLOSEOUT**
- 28 A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement
29 the requirements of Division 1.
- 30 B. Final Jobsite Observation:
- 31 1. The Architect/Engineer will not perform a final jobsite observation until the project is ready. This is
32 not dictated by schedule, but rather by completeness of the project.
- 33 2. Refer to the end of Section 27 05 00 for a "STATEMENT INDICATING READINESS FOR FINAL JOBSITE
34 OBSERVATION."
- 35 3. The Contractor shall sign this form and return it to the Architect/Engineer so that the final
36 observation can commence.
- 37 C. Before final payment will be authorized, this Contractor must have completed the following:
- 38 1. Submitted operation and maintenance manuals to the Architect/Engineer for review.
- 39 2. Submitted bound copies of approved shop drawings.
- 40 3. Record documents including edited drawings and specifications accurately reflecting field
41 conditions, **inclusive** of all project revisions, change orders, and modifications.

- 1 4. Submitted a report stating the instructions given to the Owner's representative complete with the
2 number of hours spent in the instruction. The report shall bear the signature of an authorized agent
3 of This Contractor and shall be signed by the Owner's representative as having received the
4 instructions.
- 5 5. Submitted testing reports for all systems requiring final testing as described herein.
- 6 6. Submitted start-up reports on all equipment requiring a factory installation inspection and/or start.
- 7 7. Provide spare parts, maintenance, and extra materials in quantities specified in individual
8 specification sections. Deliver to project site insert address here; submit receipt to
9 Architect/Engineer prior to final payment being approved.

10 **3.5 OPERATION AND MAINTENANCE MANUALS**

11 A. General:

- 12 1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review
13 and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's
14 comments. Once corrected, electronic copies and paper copies shall be distributed as directed by
15 the Architect/Engineer.
- 16 2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's
17 acceptance and at least 10 days prior to instruction of operating personnel.

18 B. Electronic Submittal Procedures:

- 19 1. Distribution: Email the O&M manual as attachments to all parties designated by the
20 Architect/Engineer.
- 21 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
- 22 3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper
23 originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission
24 restrictions on files; protected, locked, or secured documents will be rejected.
- 25 4. File Names: Electronic submittal file names shall include the relevant specification section number
26 followed by a description of the item submitted, as follows. Where possible, include the transmittal
27 as the first page of the PDF instead of using multiple electronic files.
- 28 a. O&M file name: O&M.div28.contractor.YYYYMMDD
29 b. Transmittal file name: O&Mtransmittal.div28.contractor.YYYYMMDD
- 30 5. File Size: Electronic file size shall be limited to a maximum of 4MB. Larger files shall be divided into
31 files that are clearly labeled as "1 of 2", "2 of 2", etc.
- 32 6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video
33 discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and
34 Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple
35 disc/flash drives are required.
- 36 7. All text shall be searchable.
- 37 8. Bookmarks shall be used, dividing information first by specification section, then systems, major
38 equipment and finally individual items. All bookmark titles shall include the nomenclature used in
39 the construction documents and shall be an active link to the first page of the section being
40 referenced.

- 1 C. Operation and Maintenance Instructions shall include:
- 2 1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors,
3 and major equipment suppliers, with addresses, telephone numbers, website addresses, email
4 addresses and point of contacts. Website URLs and email addresses shall be active links in the
5 electronic submittal.
- 6 2. Table of Contents: Include a table of contents describing specification section, systems, major
7 equipment, and individual items.
- 8 3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop
9 drawing review comments. Insert the individual shop drawing directly after the Operation and
10 Maintenance information for the item(s) in the review form.
- 11 4. Copy of final approved test and balance reports.
- 12 5. Copies of all factory inspections and/or equipment startup reports.
- 13 6. Copies of warranties.
- 14 7. Schematic wiring diagrams of the equipment that have been updated for field conditions. Field
15 wiring shall have label numbers to match drawings.
- 16 8. Dimensional drawings of equipment.
- 17 9. Capacities and utility consumption of equipment.
- 18 10. Detailed parts lists with lists of suppliers.
- 19 11. Operating procedures for each system.
- 20 12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and
21 frequency.
- 22 13. Repair procedures for major components.
- 23 14. List of lubricants in all equipment and recommended frequency of lubrication.
- 24 15. Instruction books, cards, and manuals furnished with the equipment.

25 **3.6 INSTRUCTING THE OWNER'S REPRESENTATIVE**

- 26 A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and
27 operation of the complete systems installed under this contract.
- 28 B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY
29 PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- 30 C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions
31 to facilitate this recording.
- 32 D. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the
33 Owner's representative so that their representative can be present if desirable.
- 34 E. Refer to the individual specification sections for minimum hours of instruction time for each system.

- 1 F. Operating Instructions:
- 2 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on
3 the security systems.
- 4 2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide
5 the required instructions on system operation, performance, troubleshooting, care and
6 maintenance, they shall include in the bid an adequate amount to reimburse the Owner for the
7 Architect/Engineer to perform these services.

8 **3.7 SYSTEM COMMISSIONING**

- 9 A. The security systems included in the construction documents are to be complete and operating systems. The
10 Architect/Engineer will make periodic job site observations during the construction period. The system start-
11 up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This
12 shall include all calibration and adjustments of electrical equipment controls, equipment settings, software
13 configuration, troubleshooting and verification of software, and final adjustments that may be required.
- 14 B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- 15 C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to insure
16 that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the
17 purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation,
18 resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system
19 performance, including call backs during the warranty period through no fault of the design; the Contractor
20 shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's
21 standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for
22 making payment to the Owner for services required that are product, installation or workmanship related.
23 Payment is due within 30 days after services are rendered.

24 **3.8 RECORD DOCUMENTS**

- 25 A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement
26 the requirements of Division 1.
- 27 B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials
28 used.
- 29 C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall
30 be clearly and permanently marked and noted in complete detail any changes made to the location and
31 arrangement of equipment or made to the Technology Systems and wiring as a result of building construction
32 conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses,
33 Clarifications and other supplemental instructions shall be marked on the documents. Record documents
34 that merely reference the existence of the above items are not acceptable. Should This Contractor fail to
35 complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer
36 for all costs to develop record documents that comply with this requirement. Reimbursement shall be made
37 at the Architect/Engineer's hourly rates in effect at the time of work.
- 38 D. The above record of changes shall be made available for the Architect and Engineer's examination during any
39 regular work time.
- 40 E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up
41 drawings to the Architect/Engineer.

42 **3.9 ADJUST AND CLEAN**

- 43 A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the
44 project.

- 1 B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from
2 equipment.
- 3 C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the
4 premises.

5 **END OF SECTION**

SECTION 28 13 00
ACCESS CONTROL SYSTEM (KEYSCAN)

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PART 1 - GENERAL

1.1. SUMMARY

- 31 A. The City of Madison Information Technology Department has been assisting other City agencies with
32 standardizing facilities through the use of access cards, key fobs, and punch pads. All hardware is installed locally
33 at the facility while software controls access to various doors remotely.
34 B. These specifications describe the materials, equipment, and installation requirements to install an integrated,
35 computerized access control and alarm monitoring system utilized by the City of Madison Information
36 Technology (CoM-IT) Department.
37 C. The ACS System Contractor shall be responsible for verifying equipment requirements, locations, and
38 coordination with the General Contractor and all other necessary trades as needed for a complete installation.
39

1.2. RELATED SPECIFICATIONS

- 40 A. 01 31 23 Project Management Web Site
41 B. 01 33 23 Submittals
42 C. 08 71 00 Door Hardware
43 D. 27 05 00 Basic Communication Systems Requirements
44
45

1.3. RELATED DRAWINGS

- 46 A. Refer to all Electrical drawings for locations of distribution panels and equipment as it relates to standard line
47 voltage locations.
48 B. Refer to all Technical drawings for locations of Access Control System (Keyscan) equipment.
49 C. Refer to the door hardware schedule and Architectural floor plans for information relating to door access
50 locations and specific hardware requirements.
51
52

1.4. REFERENCES

- 53 A. The system shall comply with the standards, codes and regulations of the following regulatory bodies:
54 1. Underwriters Laboratories (UL) Std No. 294 – Access Control System Units
55 2. Canadian Standards Association (CSA) Std C22.2 No. 205-M1983 – Signal Equipment
56 3. CE Standards
57 a. EN 55022 RF Emissions
58

- b. EN 55024 RF Immunity
- 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 ASSURANCE

- 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:

- 1 a. Calendar and time based lock/unlock controls
- 2 b. Group access control for common personnel groups
- 3 c. Individual access control for specialized access control
- 4 d. Temporarily disable access control for a specified time period
- 5 e. Remotely unlock/lock a door
- 6 f. Lockdown a facility from one location
- 7 g. Provide customizable alert notifications
- 8

9 **2.2. EQUIPMENT AND COMPONENTS**

- 10 A. The Contractor guarantees that all equipment and components shall be furnished new, undamaged, free of
- 11 defects, and conform to the drawings and specifications of this contract. The contractor is solely responsible for
- 12 replacing any damaged or defective item.
- 13 B. New ACS components on interior and exterior access doors shall be able to be integrated with the Owners
- 14 existing Keyscan system.
- 15

16 **2.3. DISTRIBUTION SUPPLY PANEL (AC-DS-1)**

- 17 A. AC-DS-1 brings line voltage into the ACS system with the following performance specifications:
- 18 1. Input
- 19 a. 115VAC, 60Hz, 1.45A
- 20 2. Output
- 21 a. Eight (8) PTC protected outputs
- 22 b. 16VAC output
- 23 c. 16VAC @ 10amp (175 VA) supply current (1.25 amp per device, 2.5 amp max.)
- 24 d. Outputs rated @ 2.5 amp
- 25 e. Main fuse rated @ 15 amp/32V
- 26 f. Surge suppression
- 27 3. Miscellaneous electrical information
- 28 a. Operating temperature 0° C to 49°C ambient
- 29 b. 81.89 BTU/hr
- 30 c. System AC input VA requirement 166.75 AV
- 31 4. Miscellaneous required features
- 32 a. AC power LED indicators
- 33 b. Illuminated master power disconnect circuit breaker with manual reset
- 34 5. Agency Approvals
- 35 a. UL 294 listed for Access Control System Units
- 36 b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
- 37 B. AC-DS-1 shall be:
- 38 1. Altronix, AL168175CB
- 39 2. Pre-approved equal
- 40

41 **2.4. POWER SUPPLY PANEL (AC-PS-1)**

- 42 A. The AC-PS-1 brings line voltage from the AC-DS-1, reduces then distributes the voltage to the Access Security
- 43 Panels (AC-SEC-1) with the following performance specifications:
- 44 1. Input
- 45 a. 115VAC, 60Hz, 1.9A
- 46 b. Power supply input options
- 47 i. One (1) common power input for ACM8 and lock power (factory installed)
- 48 ii. Two (2) isolated power inputs; one (1) to power the ACM8 and one (1) for lock accessory
- 49 power, (external power supply is required). Current is determined by the power supply
- 50 connected, not to exceed a maximum of 10 amp total
- 51 c. Eight (8) Access control System trigger inputs with the following options:
- 52 i. Eight (8) normally open (NO) inputs
- 53 ii. Eight (8) open collector inputs
- 54 iii. Any combination of the above
- 55 2. Output
- 56 a. 12VDC or 24VDC @ 6 amp supply current
- 57 b. Eight (8) independently controlled outputs with the following options:
- 58 i. Eight (8) Fail-Safe and/or Fail-Secure power outputs

- 1 ii. Eight (8) form "C" 5 amp rated relay outputs
- 2 iii. Any combination of the above
- 3 c. Eight (8) auxiliary power outputs (un-switched)
- 4 d. Output fuses rated @ 3.5 amp
- 5 e. Filtered and electronically regulated outputs (built-in power supply).
- 6 3. Miscellaneous electrical information
- 7 a. Operating temperature 0° C to 49°C ambient
- 8 b. BTU/hr:
- 9 i. 12VDC = 36.85 BTU/hr
- 10 ii. 24VDC = 73.70 BTU/hr
- 11 c. ACM8 board main fuse is rated at 10 amp
- 12 4. Battery Backup
- 13 a. Built-in charger for sealed lead acid or gel type batteries
- 14 b. Power supply board maximum charge current 0.7 amp
- 15 c. Automatic switch over to stand-by battery when AC fails
- 16 d. Zero voltage drop when unit switches over to battery backup (AC failure condition)
- 17 e. Battery fail and battery presence supervision (form "C" contact)
- 18 5. Miscellaneous required features
- 19 a. Fire Alarm disconnect (latching or non-latching) is individually selectable for any or all of the eight
- 20 (8) outputs.
- 21 b. Fire Alarm disconnect input options:
- 22 i. Normally open (NO) or normally closed (NC) dry contact input
- 23 ii. Polarity reversal input for FACP signaling circuit
- 24 c. Alarm output relay indicates that FACP input is triggered (form "C" contact rated @ 1 amp 28VDC)
- 25 d. Short circuit and thermal overload protection
- 26 e. AC fail supervision (form "C" contact)
- 27 f. Red LEDs indicate outputs are triggered (relays energized)
- 28 g. Green LED indicates FACP disconnect is triggered
- 29 h. AC input and DC output LED indicators
- 30 i. Enclosure accommodates up to two (2) 12AH batteries
- 31 6. Agency Approvals
- 32 a. UL 294 listed for Access Control System Units
- 33 b. CUL listed-CSA Standard C22.2 No 205-M1983 Signal Equipment
- 34 B. AC-PS-1 shall be:
- 35 1. Altronix, AL600ULACM
- 36 2. Pre-approved equal

37
38 **2.5. SECURITY PANEL (AC-SEC-1)**

- 39 A. The AC-SEC-1 distributes the reduced voltage and control wiring to/from each door with an access control
- 40 device.
- 41 B. AC-SEC-1 shall be:
- 42 1. Keyscan CA8500 – 8 Reader Access Control Panel
- 43 C. The AC-SEC-1 shall be provided, located and mounted by the Contractor in room B001A (MC-1).

44
45 **2.6. DOOR CONTROL DEVICES**

- 46 A. The Contractor shall be responsible for verifying the Door Control Device (DCD) quantities and locations with the
- 47 door hardware schedule.
- 48 B. DCD shall be:
- 49 1. Keyscan K-KPR – Keyscan Proximity Reader/Keypad, this reader accepts swipe monitoring of cards, key
- 50 bobs, and other such devices as well as accepting personal identification numbers (PINs)
- 51 i. Plan designation = AC-CR1-W

52
53 **2.7. DOOR CONTROL CABLES**

- 54 A. The following cables are required for a complete installation of the ACS, per controlled door, as follows:
- 55 1. One (1) 22/6 shielded cable, required; to DCD
- 56 2. One (1) 18/2 un-shielded cable, required; lock power
- 57 3. One (1) 22/2 un-shielded cable, required; door contact
- 58 4. One (1) 22/4 un-shielded cable, required but not used; for future request to exit sensors

- 1 B. At the Contractors option he/she may run a manufactured cable bundle containing all four (4) cables listed
2 above. It shall be the sole responsibility of the contractor to appropriately size the conduits for the installation.
3

4 **PART 3 - EXECUTION**

5
6 **3.1. COOPERATION OF THE ACS CONTRACTOR**

- 7 A. The Contractor shall be required to coordinate with all trades for a complete and timely installation. This
8 includes attending all pre-installation meetings where equipment locations, conduit locations, and control
9 devices will be installed or may be in conflict with the installation of other trades. The Contractor shall be solely
10 responsible for any additional cost required for removing/replacing/modifying any completed work by other
11 trades because the installation was not properly coordinated.
12 B. The Contractor shall coordinate with the Owners Representative from City IT for all information necessary to
13 complete the installation and integration with the Owners existing hardware and software.
14 C. The Contractor shall verify with the appropriate Owners Representative for mounting heights of all hardware
15 and equipment prior to installation. This shall be completed at a pre-installation walk through prior to rough-in.
16 D. The Contractor shall coordinate with the Owner's Representative from City IT to verify all requirements for all
17 access controlled doors are properly coordinated and understood prior to roughing in the installation.
18

19 **3.2. GENERAL EQUIPMENT MOUNTING**

- 20 A. All ACS equipment shall be mounted to the 3/4" AC fire rated plywood panels provided and installed by the
21 General Contractor. Contractor shall tape out all equipment prior to mounting to insure adequate space is
22 allotted for the complete installation per the riser diagrams including all related conduits and cables.
23 B. All equipment shall be neatly arranged so as to meet or exceed the manufacturer's recommended working space
24 around each component.
25 C. Equipment to be installed on plywood mounting panels shall include but not be limited to the following:
26 1. Distribution Service Panel (AC-DS-1)
27 2. Power Supply Panel (AC-PS-1)
28 3. Access Control Panel (AC-SEC-1)
29 4. All required conduits, and boxes for line voltage
30

31 **3.3. GENERAL CONDUITS AND WIRING**

- 32 A. This section shall apply to both the ACS Contractor and the Electrical Contractor. The following division of
33 responsibilities shall apply:
34 1. The Electrical Contractor shall be responsible for furnishing, installing, and connecting all conduits,
35 connectors, conductors, and other related materials associated with providing line voltage to the ACS
36 system as follows:
37 a. Providing an 110V, 15A, dedicated circuit from the designated distribution panel to AC-DS-1 as
38 described in Section 2.3 above.
39 b. Providing line voltage from AC-DS-1 to AC-PS-1 as described in Section 2.4 above.
40 2. The ACS Contractor shall be responsible for furnishing installing, and connecting all conduits, connectors,
41 conductors and other related materials required to complete the installation of the low voltage wiring
42 and door controller cabling.
43 B. All conduits shall be properly sized for the number of wires or wire bundles being pulled through the conduit.
44 The Contractor shall verify with the manufacturer the recommended fill rate by conduit size and shall not exceed
45 the recommendations.
46 C. The contractor shall neatly lay out all conduits in such a fashion so as to minimize bending, crossovers, etc.
47 D. Bends, pull boxes, and pull points shall be sized and located as per all applicable codes and standards for the
48 number of wires or wire bundles in the bend, pull box, pull point.
49 E. CAT6 cables from each AC-SEC-1 shall be neatly run in cable management equipment supplied and installed by
50 the cabling contractor or conduits supplied and installed by the ACS Contractor as needed. The switch to be
51 used for all ACS equipment shall be located in Telecom Room B001A. Cables shall be labeled on both ends per
52 the cabling specification.
53 F. The General Contractor and the ACS Contractor shall ensure the following Emergency Access requirements are
54 properly installed and operational prior to the final Madison Fire Department inspection for occupancy.
55 1. CoM IT shall provide a minimum of six (6) swipe cards to each installed Knox Box for emergency entrance.
56 The cards shall be appropriately coded for entry at all controlled access doors.

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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 Knox 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

SECTION 28 20 00
ELECTRONIC SURVEILLANCE

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18

19 **PART 1 – GENERAL**

20
21 **1.1. SUMMARY**

- 22 A. The City of Madison requires video surveillance of interior and exterior areas of the Pinney Library as indicated in
23 the Technology plan sheets.
24 B. This specification shall identify major equipment components and accessories required for a complete video
25 surveillance installation. It does not include materials such as cables, boxes, connectors, conduit, supports and
26 other ancillary equipment required to complete the installation.
27 C. For the purposes of this specification the term Contractor shall refer to the person(s) responsible for installing
28 the Electronic Surveillance System and may or may not be the same contractor installing other Division 27 and 28
29 related equipment. Other contractors having related work shall be referred to by full title (Electrical Contractor).
30

31 **1.2. RELATED SPECIFICATIONS**

- 32 A. 01 31 23 Project Management Web Site
33 B. 01 33 23 Submittals
34 C. 01 78 23 Operation and Maintenance Data
35 D. 01 78 36 Warranties
36 E. 01 78 39 As-Built drawings
37 F. All Division 27 specifications that may apply to this installation
38

39 **1.3. AREAS OF RESPONSIBILITY**

- 40 A. The General Contractor (GC) shall be responsible for ensuring all of the following:
41 1. Coordinate all Contractor related work with the construction schedule.
42 2. Coordinate all required Work with the Contractor and other trades during pre-installation meetings and
43 resolve installation issues as needed.
44 B. The Contractor shall be responsible for all of the following:
45 1. For all equipment ordering and purchasing, setup, configuration, and testing of equipment being installed
46 under this specification and connected to City of Madison-Information Technology (CoM-IT) servers and
47 equipment.
48 a. Include any mounting brackets required for mounting camera equipment to the structure.
49 b. The Contractor shall be responsible for the bridge supports identified in Section 2.2.C below.
50 2. Verification of Owner installation requirements prior to installing equipment and accessories.
51 3. Provide all ancillary materials and equipment required to complete the installation.
52 C. CoM-IT shall be responsible for all of the following:
53 1. The CoM-IT shall be responsible for the Exacq-Vision system licenses.
54 2. Provide connection to servers and other hardware necessary to bring installed equipment on line.
55 3. Assist in final testing of equipment and equipment functions installed under this specification.
56

1 **1.4. SUBMITTALS**

- 2 A. The Contractor shall provide submittals of the following:
- 3 1. All applicable certifications and licenses of the Contractor and the Contractor's installation team.
4 Applicable certifications and licenses shall be current from the start of the contract through the end of
5 the warranty period.
- 6 2. One (1) submittal for all ancillary Electronic Surveillance Contractor provided equipment required for a
7 complete installation as follows:
- 8 a. Product information sheets and shop drawings indicating each type/size/model of Electronic
9 Surveillance required for a complete installation. Information sheets shall include the following
10 information:
- 11 i. Performance data for the item
12 ii. Plan identification number(s) where applicable
13 iii. Quantity required for each model
14

15 **1.4. WARRANTY**

- 16 A. The Contractor shall warrant for one year the complete installation of equipment and components associated
17 with this contract and installation. Contractors warranty shall be in the form of a written letter on company
18 letterhead referring to the contract information, dates of installation and acceptance, signed by an authorized
19 representative of the Contractors Company.
- 20 1. The Contractors warranty shall include but not be limited to the following:
- 21 a. Transportation to and from the location as often as needed during the warranty period.
22 b. All labor and materials necessary to properly and thoroughly trouble shoot the system.
23 c. All fees associated with the shipping of any component that needs to be returned or supplied by
24 the manufacturer for repair or replacement.
25 d. All labor and materials required to remove, repair, replace, or re-install of any component.
- 26 B. The Contractor shall also provide all manufacturers warranties/guarantees associated with installed components
27 of the completed installation.
28

29 **PART 2 - PRODUCTS**

30
31 **2.1. EXTERIOR SURVEILLANCE LOCATIONS**

- 32 A. The exterior camera shall be a high quality outdoor ready PTZ (pan/tilt/zoom) camera as follows:
- 33 1. AXIS Communications, PTZ Dome Network Camera with the minimum requirements listed below:
- 34 a. HDTV minimum 1920 x 1080p
35 b. Certified compatible with Exacq Technologies Exacq-Vision Video Management System
36 c. 3 year AXIS extended warranty option
- 37 B. Exterior camera mounting accessories shall of high quality and rated for outdoor environments.
- 38 1. AXIS Communications, models as required for the installation of the above noted camera and locations as
39 indicated in the plans and specifications, any substitutions in camera placement to be reviewed and
40 approved by City of Madison Department of Information Technology, with all standard features including
41 the following:
- 42 a. 3 year AXIS extended warranty option
43

44 **2.2. INTERIOR SURVEILLANCE LOCATIONS**

- 45 A. The interior camera shall be a high quality indoor ready PTZ (pan/tilt/zoom) camera as follows:
- 46 1. AXIS Communications, PTZ Dome Network Camera with the minimum requirements listed below:
- 47 a. HDTV minimum 1920 x 1080p
48 b. Certified compatible with Exacq Technologies Exacq-Vision Video Management System
49 c. 3 year AXIS extended warranty option
- 50 B. Interior camera mounting accessories shall of high quality and rated for indoor environments,
- 51 1. AXIS Communications, models as required for the installation of the above noted camera and locations as
52 indicated in the plans and specifications, any substitutions in camera placement to be reviewed and
53 approved by City of Madison Department of Information Technology, with all standard features including
54 the following:
- 55 a. 3 year AXIS extended warranty option
56 b. Surface mount as per plans
57 c. Drop ceiling mount as per plans

- 1 C. All drop ceiling mount locations shall include tile bridge supports
- 2 1. ERICO, SCMKC Security Camera Mounting Kit
- 3 2. Pre-approved equal
- 4

5 **PART 3 - EXECUTION**

7 **3.1. COOPERATION OF THE CONTRACTOR**

- 8 A. All line voltage installations that may be required under this specification shall be installed by the Electrical
- 9 Contractor. Power shall come from the nearest power panel where the equipment is being installed. Label
- 10 boxes with panel and circuit number for future reference. Installation shall include any fire stopping as required
- 11 by code.
- 12 B. Data cables shall be installed by the Cabling Contractor as required for this installation. Route data cables from
- 13 the nearest Telecom Room where the equipment is being installed. Installation shall include any fire stopping as
- 14 required by code.
- 15 C. The Contractor shall install all security cameras, mounting hardware, boxes and other equipment necessary for a
- 16 complete installation of the surveillance system.
- 17

18 **3.2. EXTERIOR INSTALLATIONS**

- 19 A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong,
- 20 secure and stable installation as necessary for the building materials being mounted to.
- 21 B. Provide and install a high grade clear silicone sealant around all mounting hardware.
- 22 C. Provide sufficient cable and install a drip loop if cable is exposed outside of the mounting hardware.
- 23 D. Label camera end of data cable with permanent data tag indicating switch location connection id.
- 24 E. Label switch end of data cable with permanent data tag indicating camera location.
- 25

26 **3.3. INTERIOR INSTALLATIONS**

- 27 A. Provide and install all camera mounting hardware, fastening hardware and anchors as needed for a strong,
- 28 secure and stable installation as necessary for the building materials being mounted to.
- 29 B. Install tile bridge supports at all drop ceiling locations.
- 30 C. Label camera end of data cable with permanent data tag indicating switch location connection id.
- 31 D. Label switch end of data cable with permanent data tag indicating camera location.
- 32

33 **3.4. INSTALLATION TESTING AND ACCEPTANCE**

- 34 A. Any required system programming (by Contractor) shall be completed prior to doing any installation testing and
- 35 acceptance.
- 36 B. It is the sole responsibility of the Contractor to notify CoM-IT no less than two (2) weeks in advance of
- 37 completing the installation to coordinate all final testing of the completed system.
- 38 C. This Contractor and CoM-IT shall test each surveillance camera installation to ensure the installed components
- 39 work per the specifications.
 - 40 1. All installed components shall be inspected as follows:
 - 41 a. All connections are tight, exterior installations are weather proof with clear silicone sealant.
 - 42 b. All components are clean and free of dust, finger prints and other general dirt.
 - 43 c. Camera lenses and domes are clean and free of lint, dust and finger prints.
 - 44 d. Cameras are free to rotate.
 - 45 e. All network connectivity is complete and installed properly.
 - 46 2. Each camera installation at the project site shall be tested from an offsite computer to ensure all
 - 47 pan/tilt/zoom features, focus and other functions are fully operational.
- 48 E. A completed and accepted installation shall pass all of the above tests for each installed camera location.
- 49 F. The warranty period for the completed and accepted installation shall not begin until the date of the accepted
- 50 general contract. The Contractor shall coordinate this date with the General Contractor.
- 51
- 52

END OF SECTION

1
2
SECTION 28 31 00
FIRE ALARM AND DETECTION SYSTEMS

3 **PART 1 - GENERAL**

4 **1.1 SECTION INCLUDES**

- 5 A. Fire alarm and detection systems

6 **1.2 RELATED WORK**

- 7 A. Section 26 05 53 – Electrical Identification: Refer to electrical identification for color and identification
8 labeling requirements.

9 **1.3 QUALITY ASSURANCE**

- 10 A. Manufacturer: Company specializing in smoke detection and fire alarm systems with ten years' experience.
11 B. Installer: A factory-authorized licensed electrical or security contractor with five years' experience in the
12 design, installation and maintenance of fire alarm systems by that manufacturer.
13 C. Qualifications: The person managing/overseeing the preparation of shop drawings and the system
14 installation/programming/testing shall be trained and certified by the system manufacturer and shall be Fire
15 Alarm Certified by NICET, minimum Level 2. This person's name and certification number shall appear on the
16 start-up and testing reports.

17 **1.4 REFERENCES**

- 18 A. NFPA 70 - National Electrical Code
19 B. NFPA 72 - National Fire Alarm and Signaling Code
20 C. NFPA 101 - Life Safety Code
21 D. UL 2017 – General Purpose Signaling Devices and Systems

22 **1.5 SUBMITTALS**

- 23 A. Submit shop drawings and product data under provisions of Section 26 05 00 and as noted below.
24 1. Failure to comply with all the following and all the provisions in 26 05 00 will result in the shop
25 drawing submittal being rejected without review.
26 2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive
27 submittal will be grounds to require a complete resubmittal.
28 B. Provide product catalog data sheets as shop drawings.
29 1. Provide a product catalog data sheet for each item shown on the Electrical Symbols List and for
30 each piece of equipment that is not shown on the drawings, but required for the operation of the
31 system.
32 2. Where a particular Electrical Symbols List item has one or more variations (such as those denoted
33 by subscripts, etc.) a separate additional product catalog data sheet shall be provided for each
34 variation that requires a different part number to be ordered. The corresponding Electrical Symbols
35 List symbol shall be shown on the top of each sheet.
36 3. Where multiple items and options are shown on one data sheet, the part number and options of
37 the item to be used shall be clearly denoted.

- 1 C. Submit CAD floor plans as shop drawings:
- 2 1. The complete layout of the entire system, device addresses, auxiliary equipment, and
3 manufacturer's wiring requirements shall be shown.
- 4 2. A legend or key shall be provided to show which symbols shown on the submittal floor plans
5 correspond with symbols shown on the Contract Documents.
- 6 D. About all fire alarm circuits, provide the following: manufacturer's wiring requirements (manufacturer, type,
7 size, etc.) and voltage drop calculations.
- 8 E. Provide installation and maintenance manuals under provisions of Section 26 05 00.
- 9 F. Submit manufacturer's certificate that system meets or exceeds specified requirements.
- 10 G. Provide information on the system batteries as follows: total battery capacity, total capacity used by all
11 devices on this project, total available future capacity.
- 12 H. Submit photocopy proof of NICET certification of the person overseeing the preparation of drawings and
13 installation/testing.
- 14 I. When required to comply with local or state regulatory reviews, the fire alarm submittal shall have a
15 Professional Engineer's stamp and signature of the state in which the project is completed. NOTE: The
16 Architect/Engineer cannot stamp and seal submittal drawings not prepared under their supervision.

17 **1.6 EXTRA MATERIALS**

- 18 A. Furnish extra materials that match products installed and that are packaged with protective covering for
19 storage and identified with labels describing contents.
- 20 1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2)
21 units of each type.
- 22 a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules,
23 control modules and relays.
- 24 b. Notification appliances: Speakers, speaker strobes, and strobes.
- 25 2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or
26 resettable device/cabinet [minimum of one (1) set each] and shall turn over to the Owner upon
27 completion.
- 28 3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."

29 **1.7 DELIVERY, STORAGE, AND HANDLING**

- 30 A. Deliver products to site under provisions of Section 26 05 00.
- 31 B. Store and protect products under provisions of Section 26 05 00.

32 **1.8 REGULATORY REQUIREMENTS**

- 33 A. System: UL or FM Global listed.
- 34 B. Conform to requirements of NFPA 101.
- 35 C. Conform to requirements of Americans with Disabilities Act (ADA).

1 D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification
2 Communications.

3 **1.9 SYSTEM DESCRIPTION**

4 A. Performance Statement: This specification section and the accompanying fire alarm specific design
5 documents describe the minimum material quality, required features, and operational requirements of the
6 system. These documents do not convey every wire that must be installed and every equipment connection
7 that must be made. Based on the equipment described and the performance required of the system, as
8 presented in these documents, the Vendor and the Contractor are solely responsible for determining all
9 wiring, programming and miscellaneous equipment required for a complete and operational system.

10 B. This section of the specifications includes the furnishing, installation and connection of the microprocessor
11 controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that
12 is ready for operation. It shall include, but is not limited to, alarm initiating devices, auxiliary control devices,
13 annunciators, power supplies, and wiring as indicated on the drawings and specified herein.

14 C. Extending the existing fire alarm system: Provide all items, components, devices, hardware, software,
15 programming, expansion components, conduit, wiring etc. needed to extend the existing fire alarm system.
16 This includes, but is not limited to, additional power supplies, initiating devices and circuits, signaling devices
17 and circuits, monitoring devices and circuits, auxiliary control and related devices such as, door holders and
18 their control, smoke damper control, fan shutdown, etc. The existing fire alarm system shall be extended such
19 that the existing fire alarm system's functionality, integrity and annunciation shall be equivalent to pre-
20 construction conditions unless noted otherwise. The functionality and integrity shall be maintained during
21 construction. The entire system shall be able to be completely reset from any single reset location point. The
22 entire system shall be annunciated at any annunciation location.

23 D. Extending the existing fire alarm system: The existing control panel shall remain and shall be operational
24 throughout construction. The system shall only be disabled to make new connections and to modify the
25 programming. A fire watch shall be provided for all areas affected during outages. All system outages must
26 be scheduled with the Owner at least one week prior. Individual devices may be disabled as needed based on
27 construction activities to reduce the potential for false alarms, but all devices must be operational when the
28 Contractor is not physically on site. New initiating devices may be connected to the existing signaling line
29 circuits where capacity is available. Provide additional signaling line circuits as needed based on existing and
30 new device quantity, including replacement of existing panel components. Provide new notification circuits
31 to serve the new devices, including all necessary power supplies, amplifiers, batteries, and 120-volt input
32 circuits. All new devices shall be programmed to provide the same sequence of operation as the existing
33 devices of the same type, unless noted otherwise.

34 E. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with
35 automatic sensitivity control of certain detectors, multiplexed signal transmission.

36 F. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and
37 Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling
38 circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.

39 G. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have
40 cleared.

41 H. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and
42 at annunciator panels.

43 I. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and
44 additional equipment to make a complete and functioning system has not been shown, but shall be submitted
45 on the shop drawings.

1 **1.10 PROJECT RECORD DOCUMENTS**

- 2 A. Submit documents under the provisions of Section 26 05 00.
- 3 B. Include location of end-of-line devices.
- 4 C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on
5 the project and its address. The devices shall be shown in their installed location and shall be labeled with the
6 same nomenclature as is used in the fire alarm panel programming.
- 7 D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on
8 the floor plan. Notification devices shall have the tap wattage designated.

9 **1.11 OPERATION AND MAINTENANCE DATA**

- 10 A. Submit data under provisions of Section 26 05 00.
- 11 B. Include operating instructions, and maintenance and repair procedures.
- 12 C. Include results of testing of all devices and functions.
- 13 D. Include manufacturer's representative's letter stating that system is operational.
- 14 E. Include the CAD floor plan drawings.
- 15 F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

16 **1.12 WARRANTY**

- 17 A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- 18 B. Warranty requirements shall include furnishing and installing all software upgrades issued by the
19 manufacturer during the one (1) year warranty period.

20 **PART 2 - PRODUCTS**

21 **2.1 ACCEPTABLE MANUFACTURERS**

- 22 A. To be compatible with existing system.

23 **2.2 SIGNALING LINE CIRCUIT DEVICES**

- 24 A. **[FA-120]:** Smoke Detectors:
- 25 1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density
26 and send data to the control panel representing the analog level of smoke density measured.
- 27 2. Each smoke detector shall connect directly to an SLC loop.
- 28 3. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all
29 mounting hardware provided. Provide a two-piece head/base design.
- 30 4. Each detector shall have a manual switching means to set the internal identifying code (address) of
31 that detector, which the control panel shall use to identify its address with the type of sensor
32 connected.

- 1 5. Dual alarm and power indicators shall be provided that flash under normal conditions and remain
2 continuous under alarm or trouble conditions. Remote indicator terminals shall be provided.
3 Provide a remote LED indicator device if detector is not visible from a floor standing position.
- 4 6. A test means shall be provided to simulate an alarm condition.
- 5 7. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall
6 be installed with a unique monitor module located in the nearest available location with maintained
7 temperatures between 32°F and 120°F.
- 8 8. Audible sounder detector base for sleeping room applications:
- 9 a. The audible base shall sound an alarm in the local room in UL2017 operation and UL484
10 for general evacuation. The unit shall be programmable by the main control panel for the
11 duration of operation.
- 12 b. The audible sounder base shall sound Temporal 3 (fire) or Temporal 4 (CO alarm) and be
13 at 75 dB at 10 feet.
- 14 9. A subscript is used to identify the device with a specific sequence of operation as follows: E=Elevator
15 Recall, S=Sleeping/Patient Room, D=HVAC Control, A=Atrium, SW=Stairwell, CR=Computer Room,
16 SD=Smoke Dampers, DH=Door Hold Release, FD= Fire Door Release, MP=Medical Procedure Room.
- 17 B. **[FA-121]:** Projected Beam Type Detectors:
- 18 1. This device shall utilize photoelectric analog smoke sensor technology. Provide with transmitter and
19 associated receiver. Microprocessor-based detector shall provide a minimum of eight sensitivity
20 levels, temperature and dirt compensation, and automatic gain control. Sensor to contain beam
21 alignment adjustments and receiver calibration.
- 22 2. Detector shall connect directly to an SLC loop or shall be provided with multiple monitor modules,
23 as required, to connect to the SLC loop and for monitoring alarm and trouble output contacts. The
24 detector shall be provided complete with all mounting hardware provided and installed where
25 indicated on the drawings.
- 26 3. Dual alarm and power indicators shall be provided that flash under normal conditions and remain
27 continuous under alarm or trouble conditions. Remote indicator terminals shall be provided.
- 28 4. Provide with remote indicator panel providing LED indications of alarm and trouble.
- 29 C. **[FA-122]:** Duct Smoke Detectors:
- 30 1. Duct-type smoke detectors shall use the same analog photoelectric sensor technology, with the
31 same features specified for standard smoke detectors, except with additional features as specified
32 below.
- 33 2. Provide sampling tubes and mounting hardware to match the duct to which it is attached. Where
34 the detector housing is larger than the duct height, the Contractor shall fabricate a mounting
35 bracket for the detector and attach according to the fire alarm manufacturer's recommendations.
- 36 3. Provide a remote alarm LED indicator device (FA-240/241) if detector is not visible from a floor-
37 standing position. If detector is located above a suspended ceiling, mount remote indicator in
38 ceiling directly below detector with a white single-gang faceplate labeled: Duct Smoke Detector.
- 39 D. **[FA-123]** In-Duct Smoke Detectors:
- 40 1. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density
41 and send data to the control panel representing the analog level of smoke density measured.

- 1 2. Low Flow Type: Listed for use in duct with 0-2000 feet per minute velocity.
- 2 3. Each smoke detector shall connect directly to an SLC loop.
- 3 4. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all
4 mounting hardware provided to match the duct application. Provide a two-piece head/base design.
- 5 5. Each detector shall have a manual switching means to set the internal identifying code (address) of
6 that detector, which the control panel shall use to identify its address with the type of sensor
7 connected.
- 8 6. Provide a remote LED indicator device (FA-240/241), mounted in ceiling directly below detector
9 with a single-gang faceplate labeled: Duct Smoke Detector.
- 10 E. Manual Pull Stations:
 - 11 1. Manual stations shall match the description on the drawings (refer to the General Electrical
12 Equipment Schedule). The stations shall be mounted where shown on the drawings and be provided
13 with all necessary mounting hardware. Use surface mount only on precast concrete or structure.
 - 14 2. **[FA-130]:** Addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red
15 high abuse plastic or cast metal construction with white lettering.
 - 16 3. **[FA-131]:** Addressable, double action with plastic breakrod, reset key lock, semi-flush mount, red
17 high abuse plastic or cast metal construction with white lettering. Provide device with clear Lexan
18 tamper resistant cover with integral 9V battery powered alarm that sounds when shield is lifted.
 - 19 4. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means
20 using rotary decimal or DIP switches.
 - 21 5. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall
22 be installed with a unique monitor module located in the nearest available location, with
23 maintained temperatures between 32°F and 120°F.
- 24 F. Heat Detectors:
 - 25 1. **[FA-140]:** Combination rate of rise and 135°F fixed temperature analog thermal type sensor. Factory
26 programmed to alarm at 135°F and at 15°F per minute rate-of-rise. Sensor shall measure heat level
27 and send data to the control panel representing the analog level of thermal measurement and rate-
28 of-rise.
 - 29 a. A subscript is used to identify the device with a specific sequence of operation as follows:
30 E=Elevator Shutdown.
 - 31 2. **[FA-141]:** 200°F fixed temperature. Provide a remote addressable monitor module to interface with
32 addressable system as shown on the plans.
 - 33 3. Provide a two-piece head/base design, with a manual switching means to set the internal identifying
34 code (address) of that detector, which the control panel shall use to identify its address with the
35 type of sensor connected.
 - 36 4. Heat detectors shall connect directly to SLC loops. Where fixed temperature or explosion proof
37 detectors are used, one monitor module may be used to monitor all detectors in one room/area as
38 shown on the drawings.
 - 39 5. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting
40 hardware provided.

- 1 6. Provide a remote LED indicator device if detector is not visible from a floor-standing position.
- 2 7. Dual alarm and power indicators shall be provided that flash under normal conditions and remain
- 3 continuous under alarm or trouble conditions. A connection for attachment of a remote indicator
- 4 shall be provided.
- 5 8. A test means shall be provided to simulate an alarm condition.
- 6 9. Where operation is noted as required below 32°F and/or above 120°F, a conventional device shall
- 7 be installed with a unique monitor module located in the nearest available location with maintained
- 8 temperatures between 32°F and 120°F.
- 9 G. **[FA-150]: Carbon Monoxide/Heat/Smoke Combination Detector:**
- 10 1. Multi-criteria sensor for photoelectrical smoke sensing, heat and carbon monoxide (CO) detection.
- 11 Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075
- 12 standards.
- 13 2. The combined photoelectric smoke detection/heat/CO module shall have separate sensors that
- 14 adjust the detection profile in response to the input from the sensors.
- 15 3. The combined photoelectric smoke detection / CO module shall have selectable modes of operation
- 16 for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.
- 17 4. The detector shall use only one address on the SLC.
- 18 5. CO sensor cartridge element shall be field replaceable.
- 19 H. **[FA-160]: Monitor Modules:**
- 20 1. Monitor Module shall connect directly to an SLC loop and receive power from a separate 24 VDC
- 21 circuit. It shall interface initiating devices with the control panel using Style D or Style B circuits.
- 22 Contractor option: Use an interface module (2-wire operation) for Style B circuits connected to
- 23 normally-open dry contacts, such as a flow switch.
- 24 2. The module shall be mounted in an enclosure located in an accessible service location as near as
- 25 possible to the device(s) being monitored, or where shown on the drawings. All mounting hardware
- 26 shall be provided.
- 27 3. The module shall supply the required power to operate the monitored device(s).
- 28 4. The module shall provide address setting means using rotary decimal or DIP switches.
- 29 I. **[FA-161]: Addressable Relays:**
- 30 1. Relay that represents an addressable control point used primarily for the control of auxiliary devices
- 31 as indicated on the drawings. Contractor to provide additional slave relay(s), as required, rated for
- 32 the electrical load being controlled (contractor to match voltage, amps, etc.).
- 33 2. Relay shall connect directly to an SLC loop and receive power from a separate 24 VDC circuit.
- 34 3. The relay shall be mounted in an enclosure located in an accessible service location as near as
- 35 possible to the device(s) being controlled, unless otherwise shown on the drawings. All mounting
- 36 hardware shall be provided.
- 37 4. The relay shall supply 24 VDC power to the device(s) being controlled, unless otherwise indicated
- 38 on the drawings.

- 1 **2.3 NOTIFICATION APPLIANCE DEVICES**
- 2 A. Confirm voice or horn for existing fire alarm system with building developer prior to installation.
- 3 B. Device Color:
- 4 1. Wall Mounted: White housing with red lettering or pictogram.
- 5 2. Ceiling Mounted: White housing with red lettering or pictogram.
- 6 C. Visual Alarm Devices:
- 7 1. **[FA-200]**: Wall mounted.
- 8 2. **[FA-201]**: Ceiling mounted.
- 9 3. High intensity (candela rating as scheduled on the drawings) xenon strobe or equivalent under a
10 lens. Candela rating shall be visible from exterior of the device.
- 11 a. Candela Ratings: V1=15, V3=30, V7=75, VH=110, VS=177.
- 12 4. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate
13 shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual
14 devices shall be synchronized.
- 15 5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.
- 16 D. Audio (Horn) Alarm Devices:
- 17 1. **[FA-210]**: Wall mounted.
- 18 2. **[FA-230]**: Ceiling mounted.
- 19 3. Sound Rating: 85 dB at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA in the
20 occupied area.
- 21 4. Device shall be capable of a high and low dB level setting. Unless noted otherwise, the device shall
22 be set to the high setting at building completion.
- 23 5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.
- 24 E. Combination Audio (Horn) and Visual Notification Device:
- 25 1. **[FA-211]**: Wall mounted.
- 26 2. **[FA-231]**: Ceiling mounted.
- 27 3. Combine horn and visual components into a single device. Refer to the corresponding paragraphs
28 above for requirements of each component.
- 29 F. **[FA-203]**: Weatherproof Visual Notification Device:
- 30 1. High intensity strobe, square housing, 75 candela rating, suitable for wet locations. Provide with
31 weatherproof back box.
- 32 2. Mounting: Semi-flush wall.
- 33 3. Conduit shall not be exposed.

- 1 G. **[FA-212]:** Weatherproof Audio/Visual Notification Device:
- 2 1. Electronic horn with high intensity strobe, square housing, 75 candela, suitable for wet locations.
3 Provide with weatherproof back box.
- 4 2. Mounting: Semi-flush wall.
- 5 3. Conduit shall not be exposed.
- 6 **2.4 [NEP-#]: NAC EXTENDER PANELS (NEP)**
- 7 A. As shown on the plans or as a Contractor's option if not shown, furnish and install NAC extender panels as
8 necessary to provide remote power supply for notification appliance circuits (NAC). Contractor shall indicate
9 quantity and locations of each NEP on the shop drawing submittals.
- 10 B. Each NEP shall be self-contained remote power supply with batteries, and battery charger mounted in a
11 surface lockable cabinet. Battery capacity shall be sufficient for operation for 24 hours in a non-alarm state
12 followed by alarm for 15 minutes, plus 25% spare capacity for future devices. Each NEP provides a minimum
13 of up to 4 outputs, 2A continuous, or 6A full load total capacity.
- 14 C. Power for each NEP shall be from a local 120 VAC circuit. Provide two #12 conductors and one #12 ground in
15 1/2" conduit to each NEP from a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's
16 standard handle lock-on device. Coordinate panel and circuit number with Architect/Engineer prior to
17 installation.
- 18 D. NAC extender panels may be installed only in locations coordinated with the Architect/Engineer.
- 19 E. Mounting: Surface.
- 20 **2.5 ANNUNCIATION**
- 21 A. **[FAA-#]:** Remote LCD Annunciators:
- 22 1. Auxiliary annunciators shall indicate alarm and trouble conditions visually and audibly as shown on
23 the drawings. Provide local TROUBLE ACKNOWLEDGE, TEST, and ALARM SILENCE capability.
24 Minimum 80-character display.
- 25 2. Communications and power to the annunciators shall be supervised. The annunciator shall receive
26 power from the fire alarm control panel.
- 27 3. A single key switch shall enable all switches on the annunciator.
- 28 4. Mounting: Flush.
- 29 B. **[FA-241]:** Fire Alarm Remote Indicator:
- 30 1. Red LED type.
31 2. Mounts flush to a single gang box.
- 32 C. **[FA-242]:** Fire Alarm Remote Indicator and Test Switch:
- 33 1. Red LED type.
34 2. Key switch test selector.
35 3. Mounts flush to a single gang box.

1 **2.6 CONNECTIONS TO AUXILIARY DEVICES PROVIDED BY OTHERS**

2 A. **[FA-250]:** Smoke Damper:

3 1. Motorized type, furnished and installed by MC. Fire alarm control and power connections by EC. A
4 subscript is used to identify the device with a specific air handler or zone for its sequence of
5 operation. Refer to the Operation Matrix and these specifications for complete requirements.

6 B. **[FA-254]:** Duct Smoke Detector and Smoke Damper Control:

7 1. Sampling type duct detector [FA-122] in ducts 18" and larger. In-duct smoke detector [FA-123] in
8 ducts less than 18". Detector shall be mounted within 5' of smoke damper. Motorized type smoke
9 damper furnished and installed by MC. Fire alarm control and power connections by EC. Remote
10 indicator [FA-241] or [FA-242] mounted in visible location. Provide auxiliary relay base or
11 addressable control module. The smoke damper shall close upon activation of the detector, and a
12 supervisory signal shall be sent to the fire alarm control panel.

13 C. **[FA-260]:** Flow Switch:

14 1. Connection to flow switch to monitor fire protection flow switch or discharge output contacts.
15 Normally open dry contacts for fire alarm interface. Furnished and installed and MC; wired by EC.

16 D. **[FA-261]:** Monitor Switch:

17 1. Connection to monitor switch to monitor fire protection system supervisory switches or output
18 contacts. Normally open dry contacts for fire alarm interface. Furnished and installed by MC; wired
19 by EC.

20 **2.7 WIRING**

21 A. Fire alarm wiring/cablings shall be furnished and installed by the Contractor in accordance with the
22 manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled
23 as complying with NFPA 70, Article 760 for power-limited fire alarm signal service.

24 B. Approved manufacturers of fire alarm cable:

- 25 1. Comtran Corp.
26 2. Helix/HiTemp Cables, Inc.
27 3. Rockbestos-Suprenant Cable Corp.
28 4. West Penn Wire/CDT.
29 5. Radix.

30 **PART 3 - EXECUTION**

31 **3.1 SEQUENCES OF FIRE ALARM OPERATION**

32 A. General:

33 1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system
34 operation.

35 2. All system output programs assigned via control-by-event equations to be activated by the
36 particular point in alarm shall be executed, and the associated system outputs (alarm notification
37 appliances and/or relays) shall be activated.

- 1 B. Panel/Annunciator Alarm, Trouble, Supervisory Indication:
- 2 1. Appropriate system Alarm, Trouble, or Supervisory LED shall flash at the control panel, transponder,
3 and annunciator locations.
- 4 2. A local signal in the control panel shall sound.
- 5 3. The LCD display shall indicate all information associated with the condition, including the name of
6 the item, type of device and its location within the protected premises.
- 7 4. History storage equipment shall log the information associated with the fire alarm control panel
8 (FAP) condition, along with the time and date.
- 9 5. Transmit the appropriate signal (supervisory, trouble, alarm) to the central station via the digital
10 communicator.
- 11 C. Audible Alarms Sequence:
- 12 1. Audible alarms within the floor or fire/smoke compartment where the emergency signal originated
13 shall sound.
- 14 D. Visual Alarms Sequence:
- 15 1. Visual alarms within the floor or fire/smoke compartment where the emergency signal originated
16 shall flash.
- 17 E. Smoke Damper Control Sequence:
- 18 1. The fire alarm system shall utilize an addressable relay to open the power connection to smoke or
19 fire/smoke dampers and allow them to close. Coordinate other requirements with damper installer.
- 20 2. Where a damper is in a main air duct, where closure of that single damper will entirely block airflow
21 in the duct system, the smoke damper sequence shall also initiate the AHU shutdown sequence for
22 the affected unit.
- 23 3. The AHU shutdown sequence shall be initiated only when ALL the dampers associated with that
24 unit are closed. Otherwise, the AHU shall continue to serve other areas.
- 25 4. Smoke and fire/smoke dampers located in branch ductwork shall be closed individually or in groups,
26 as identified on the plans.
- 27 F. AHU Shutdown Sequence:
- 28 1. The fire alarm system shall utilize addressable relays to de-energize all AHU motor controllers.
29 Coordinate other requirements with HVAC installer.
- 30 2. The fire alarm system shall directly shut down the AHU through the local HVAC control device (i.e.,
31 variable frequency drive or motor starter).
- 32 3. Where a facility has more than one AHU, each shall be shutdown individually based on input from
33 initiation devices in the area served by the unit or designated for each AHU.
- 34 G. Sound Masking/Paging System Shutdown Sequence:
- 35 1. The fire alarm system shall utilize addressable relays or RS-485 interface to disconnect the signal
36 source or de-energize the amplifiers to shut down all sound masking/paging systems. Coordinate
37 with masking/paging system supplier to provide necessary interface at all sound system equipment
38 locations.

- 1 c. Duct-type detectors shall be installed according to the manufacturer's instructions.
- 2 6. In-Duct Analog Smoke Detectors:
- 3 a. In-duct analog smoke detectors shall be installed in the duct where shown on the
4 drawings and details. The devices shall be installed in the respective duct at the
5 approximate location where shown on the electrical drawings to meet the operation
6 requirements of the system.
- 7 b. All detectors shall be accessible.
- 8 7. Manual Pull Stations:
- 9 a. Stations shall be located where shown and at the height noted on the drawings.
- 10 8. Addressable Relays and Monitor Modules:
- 11 a. Modules shall be located as near to the respective monitor or control devices as possible,
12 unless otherwise indicated on the drawings.
- 13 b. All modules shall be mounted in or on a junction box in an accessible location.
- 14 c. Where not visible from a floor standing position, a remote indicator shall be installed to
15 allow inspection of the device status from a local floor standing location.
- 16 9. Notification Appliance Devices:
- 17 a. Devices shall be located where shown on the drawings.
- 18 b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted
19 on the drawings.
- 20 D. Annunciators:
- 21 1. Remote Annunciators: The annunciators shall be located where shown on the drawings and
22 approved by the fire marshal.
- 23 E. Wiring:
- 24 1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's
25 recommendations and pursuant to National Fire Codes.
- 26 2. Wiring shall be installed in conduit. Refer to Identification Section 26 05 13 for color and
27 identification requirements.
- 28 3. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification
29 Section 26 05 13 for color and identification requirements.
- 30 4. Partial evacuation or relocation of occupants is the standard operating procedure for this facility in
31 the event of an alarm. Therefore, all notification appliance circuits (NAC), including circuits serving
32 NAC extender panels (NEP) and other network communication circuits, must be installed and
33 protected in accordance with the "circuit survivability" requirements described in NFPA 72. The
34 contractor shall maintain the following:
- 35 a. NACs serving separate evacuation signaling zones shall be routed separately such that
36 they are no less than 4 feet apart when run horizontally and 1 foot apart when run
37 vertically. They may come simultaneously only within 10 feet of the control panel.

- 1 b. NACs passing through other evacuation signaling zone(s) shall be installed in conduit and
2 routed through the 2-hour fire-rated chase(s) or enclosure(s) identified on the drawings.
- 3 5. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 26 05 13.
- 4 6. Notification Appliance Circuits shall provide the features listed below. These requirements may
5 require separate circuits for visual and audible devices.
- 6 a. Fire alarm temporal audible notification for all audio appliances.
- 7 b. Synchronization of all visual devices where two or more devices are visible from the same
8 location.
- 9 c. Ability to silence audible alarm while maintaining visual device operation.
- 10 7. Notification Appliance Circuits shall not span floors or smoke compartments.
- 11 8. Signal line circuits connecting devices shall not span floors or two-hour smoke compartments.
- 12 9. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire
13 protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent
14 possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut
15 type connectors. Transposing or changing color coding of wires shall not be permitted. All
16 conductors in conduit containing more than one wire shall be labeled on each end, in all junction
17 boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully
18 formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals
19 shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control
20 panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.
- 21 F. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using
22 colored tape at each conductor termination and in each junction box.
- 23 1. Power branch circuit conductors: In accordance with Section 26 05 53.
- 24 2. Signaling line circuit: Overall red jacket with black and red conductors.
- 25 3. DC power supply circuit: Overall red jacket with violet and brown conductors.
- 26 4. Notification appliance circuit: Overall red jacket with blue and white conductors.
- 27 5. Door release circuit: Gray conductors.
- 28 6. Central station trip circuit: Orange conductors.
- 29 7. Central station fire alarm loop: Black and white conductors.
- 30 G. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm
31 equipment supplier. Backboxes shall be painted to match device, shall be the same shape and size as the
32 device shall not have visible knockouts.
- 33 H. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler
34 valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other
35 system devices shown or noted on the Contract Documents or required in the manufacturer's product data
36 and shop drawings.
- 37 **3.3 FIELD QUALITY CONTROL**
- 38 A. Field inspection and testing will be performed under provisions of Section 26 05 00.
- 39 B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation
40 with O & M manuals in accordance with Section 14.6 of the Code.

- 1 C. Contractor shall test and adjust the fire alarm system as follows:
- 2 1. Speaker taps shall be adjusted to the lowest tap setting which achieves a sound level higher than
3 or equal to the greatest of the following:
- 4 a. 70dBA.
- 5 b. 15 dBA above ambient levels as indicated in NFPA 72 Table A.18.4.3.
- 6 c. 15 dBA above measured ambient. 5 dBA above the maximum measured sound level with
7 duration of more than 60 seconds.
- 8 d. As specified on the drawings.
- 9 2. Sound level measurement procedure shall meet the following requirements:
- 10 a. All measurements shall use the 'A' weighted, dBA, sound measurement scale.
- 11 b. All measurements shall be taken after furnishings, wall coverings and floor coverings are
12 in place.
- 13 c. All measurements shall be taken after fixed equipment (HVAC units, etc.) producing
14 ambient noise is installed and is in operation.
- 15 d. Final ambient sound measurements shall be taken during occupancy and the units shall
16 be re-adjusted at that time, if necessary.
- 17 e. All sound level measurements shall be taken at a height of 5' above the finished floor
18 level.
- 19 f. Measurements shall be taken in every unique room. If there are multiple rooms, which
20 have the identical dimensions and function, 10%, or a minimum of 2 rooms shall be
21 tested. The results from the rooms tested shall be averaged and the remaining rooms may
22 be adjusted per the average.
- 23 g. Measurements shall be taken on a 20' x 20' grid and the results for all points taken shall
24 be averaged. If the room is smaller than 20' x 20' a minimum of two measurements are
25 required.
- 26 h. Measurements shall be taken halfway between speakers or halfway between a speaker
27 and the wall. No measurements shall be taken at the extreme edges of the room, nor
28 directly under speakers.
- 29 D. Additionally, test the voice alarm communication system intelligibility per IEC 60849:
- 30 1. The following acoustically distinguishable spaces shall be tested: All unique rooms shall be tested.
31 If there are multiple rooms with the identical dimensions and function, 10%, or a minimum of two
32 (2) rooms, shall be tested. The results from the rooms tested shall be averaged, and the remaining
33 rooms may be adjusted per the average.
- 34 2. Utilize7 equipment designed to test per IEC 60849 per the equipment manufacturer's instructions.
35 This equipment includes a signal generator, which is input to the fire alarm system and a portable
36 measurement device. This equipment is available from Simplex Grinnell or Gold Line.
- 37 3. Testing equipment that can simulate 'crowd babble' shall be used in rooms with occupancy of
38 greater than 200.

- 1 4. Wide-area notification intelligibility shall be tested in acoustically distinguishable spaces and areas
2 as designated by the Owner.
- 3 5. When testing for intelligibility, the quantity and location of the measurement points shall be the
4 same as the points used for measurement of dBA level.
- 5 6. Provide a room by room report, showing the average dBA level and STI for each room tested, the
6 number and location of. The report shall be presented to the Architect/Engineer in an Excel .xls file.

7 **3.4 MANUFACTURER'S FIELD SERVICES**

- 8 A. Provide manufacturer's field services under provisions of Section 26 05 00.
- 9 B. Include services of certified technician to supervise installation, adjustments, final connections, and system
10 testing.
- 11 C. Note that room numbers depicted on the architectural/engineering drawings will not necessarily reflect the
12 actual room (signage) numbers that the Owner selects. The Contractor and fire alarm manufacturer shall
13 coordinate the actual room numbers as the Owner directs to identify each device. This list shall be a part of
14 the floor plan record drawing to be turned in at the project closeout.

15 **3.5 SYSTEM TRAINING**

- 16 A. System training shall be performed under provisions of Section 26 05 00.
- 17 B. Minimum on-site training times shall be:
 - 18 1. System Operators: One (1) day.
 - 19 2. Emergency Communication System: Four (4) hours.

20 **END OF SECTION**

**SECTION 32 18 16.13
PLAYGROUND PROTECTIVE SURFACING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Protective surfacing for playground area.
- B. Subbase under resilient surfacing.
- C. Containment curbs.

1.2 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- A. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2017a.
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2014.
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012, with Editorial Revision (2015).
- D. ASTM F1292 - Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment; 2017.
- E. ASTM F1487 - Standard Consumer Safety Performance Specification for Playground Equipment for Public Use; 2017.
- F. ASTM F1951 - Standard Specification for Engineered Wood Fiber for Determination of Accessibility of Surface Systems Under and Around Playground Equipment
- G. ASTM F2075 - Standard Specification for Engineered Wood Fiber for Use as a Playground Safety Surface Under and Around Playground Equipment; 2015.
- H. CPSC Pub. No. 325 - Public Playground Safety Handbook; 2010.

1.4 DEFINITIONS

- A. Use Zone: The area beneath and immediately adjacent to a play structure or equipment (play event) that is designated for unrestricted circulation around equipment, and on whose surface it is predicted that a user would land when falling from or exiting the equipment.
- B. Critical Fall Height: The maximum fall height at which the protective surfacing meets the requirements of ASTM F1292.
- C. High Play Activity Area: Areas where the fall height is especially great, such as at swings. A high play activity area is defined only where the protective surfacing of the entire playground area is not designed for the greatest fall height. High play activity areas are defined on the drawings.
- D. Fall Height: The vertical distance between the finished elevation of the designated play surface and the finished elevation of the protective surfacing beneath it as defined by ASTM F1487.
- E. Protective Surfacing: Resilient ground surfacing. The characteristics of the protective surfacing are based on the fall height of the playground equipment. Changes in either the surfacing or the fall height, particularly reducing the resilience of the protective surfacing or increasing the fall height, will reduce safety-related performance.
- F. Aggregate Base: A layer under the resilient layer of the protective surfacing but over the subgrade.
- G. Subgrade: The surface of the ground on which the aggregate base is installed.

1.5 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: For all manufactured surfacing products, provide manufacturer's product data showing materials of construction, compliance with specified standards, installation procedures, and safety limitations.
 - 1. Include IPEMA certifications where required.
 - 2. Treated Wood Products: Provide information on wood treatment chemical content, toxicity level, and life-cycle durability.
- C. Product Data: For natural surfacing materials, provide supplier's certification or mill certificate showing compliance with specified requirements.
- D. Shop Drawings: Detailed scale drawings showing locations of proposed playground equipment and exposed footings, bases, and anchorage points.
 - 1. Clearly identify footing and base elevations in relation to a fixed survey point on site and to subgrade elevation and depth of protective surfacing, surveyed by land surveyor licensed in the State in which the Project is located.
 - 2. Show locations of underground utilities, storm-drainage system and irrigation system.
 - 3. Show locations of related construction such as walkways, fences, site furnishings, and plantings.
 - 4. Show measured fall height for each playground equipment item, determined in accordance with ASTM F1487.

- 5. Show Use Zone perimeters, determined in accordance with ASTM F1487.
- E. Samples: For each product specified.
- F. Percolation Test Report: Describing test method used and results.
- G. Maintenance Data:
 - 1. For manufactured surfacing products, provide manufacturer's recommended maintenance instructions and list of repair products, with address and phone number of source of supply.
 - 2. For loose fill surfacing products, provide detailed re-ordering information to enable City of Madison to match installed material exactly.
- H. Manufacturer's Field Report.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of the latest edition of ASTM F1487 and CPSC Pub. No. 325 at project site.
- B. Manufacturer Qualifications: Company regularly engaged in manufacturing products specified in this section, with not less than three years of documented experience.
 - 1. Surfacing installed in minimum 10 sites and been in successful service minimum 5 years.
 - 2. Provide certificate of Insurance AA rated for minimum 1,000,000 dollars covering both product and general liability.
 - 3. Manufacturer's Representative: Provide name, company name and address, and qualifications.
- C. Installer Qualifications: Company certified by manufacturer for training and experience installing the protective surfacing; provide installer's company name and address, and training and experience certificate.

1.7 PRE-INSTALLATION MEETING

- A. Coordinate with Section 11 6813.
- B. Convene a meeting one week before starting earthwork for playground to discuss coordination between various installers.
 - 1. Require attendance by personnel responsible for grading and installers of playground equipment, protective surfacing, footings, and adjacent work.
 - 2. Include representatives of Contractor.
 - 3. Notify Architect at least 2 weeks prior to meeting.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store protective surfacing to project site in accordance with manufacturer's recommendations.
- B. Store materials in a dry, covered area, elevated above grade.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

- A. Because the safety of the playground depends on strict conformance to the design criteria, this information is provided for Contractor's information.
 - 1. The protective surfacing constitutes a resilient layer installed over an aggregate base, which is installed over the subgrade, with the top of playground equipment footings and anchorage devices covered by full depth of the resilient portion of the protective surfacing.
 - 2. The top elevation of the protective surfacing is intended to be flush with adjacent grades.
- B. If deviation from specified depth is required, it is the Contractor's responsibility to make all changes required to maintain specified top elevation and required impact attenuation at no extra cost to City of Madison; obtain approval prior to proceeding; follow approval request procedure as specified for substitutions.

2.2 MATERIALS

- A. Synthetic Grass Safety Surface System: Consisting of synthetic grass fabric, synthetic grass infill, and pad underlayment, over aggregate base and soil separation geotextile.
 - 1. Synthetic Grass: 1.75 inch XGrass Synthetic Turf for Play Areas, 210 Howell Drive, Dalton, GA 3072; Phone (877) 881-8477 or approved equal.
 - a. Face weight: 50oz./sy
 - b. Face Yarn Type: Polyethylene
 - c. Yarn Size: 10800/7300
 - d. Pile Height: 1.75 inches
 - e. Color: Blend

- 1 f. Construction: Broodoom tufted
- 2 g. Stitch Rate: 8 per 3 inches
- 3 h. Turfing Gage: 1/4"
- 4 i. Primary backing: Stabilized dual layered woven polypropylene
- 5 j. Secondary backing: 10 oz. Duraflo
- 6 k. Total Product Weight: 68.7 oz/sy
- 7 l. Finished Roll Width: 180" untrimmed
- 8 m. Warranty: 10 year fade
- 9 2. Pad Underlayment System: Sofpad Standard recycled, non-contaminated, post-industrial cross-link, closed cell
- 10 polyethylene - polyolefin foam pad from XGrass.
- 11 a. Foam type: Polyethylene - Polyolefin
- 12 b. Buld Density: 5.0-8.0 lbs/cu ft
- 13 c. Effective Size: 24 sq ft (net coverage)
- 14 d. Tensile Strength: 34-36 psi
- 15 3. Synthetic Grass Infill: Envirofill from XGrass, 210 Howell Drive, Dalton, GA 3072; Phone (877) 881-8477 or approved
- 16 equal.
- 17 a. Coating: Priority acrylic, iron oxide and chromium oxide
- 18 b. Grain shape: Hardness 6-8 Mohs
- 19 c. Curvature: 0.7+
- 20 d. Specific Gravity: 1.76 g/cm3
- 21 e. Bulk Density: 110 lbs/cu ft
- 22 f. Uniform Coefficient: 1.10 to 1.40
- 23 g. Effective Size: .84-1.68 mm
- 24 4. Nailer Board: Pressure-treated board, minimum nominal thickness of 1" x width per application
- 25 5. Splicing Material: 1000 denier coated nylon (Cordura) 12" wide minimum
- 26 6. Adhesive: Synthetic Turf Adhesive from XGrass
- 27 7. Soil Separation Geotextile: US 200 Woven Geotextile from US Fabrics: [https://www.usfabricsinc.com/products/us-](https://www.usfabricsinc.com/products/us-200)
- 28 [200](https://www.usfabricsinc.com/products/us-200)
- 29 B. Engineered Wood Fiber Fill: Manufactured for the purpose of protective surfacing; complying with ASTM F1951 and ASTM
- 30 F2075; do not use mulch manufactured from recycled pallets, or lumber containing nails or metal fasteners.
- 31 1. Depth: 18 inches.
- 32 2. Manufacturers:
- 33 a. Fibar Systems; Fibar Engineered Wood Fiber (EWF): www.fibar.com.
- 34 b. GameTime, Inc; GT Impax: www.gametime.com.
- 35 c. Sof' Fall; Sof'fall Engineered Wood Fiber: www.sof-fall.com.
- 36 d. Substitutions: See Section 01 6000 - Product Requirements.
- 37 C. Geotextile Fabric: Nonwoven polypropylene sheet.
- 38 D. Containment Curbs: Boards or timbers as indicated; free of sharp vertical edges, protruding elements, and trip hazards;
- 39 free of holes, cracks, and loose knots; do not use wood or wood coatings that contain pesticides .
- 40 1. Species: lpe; heartwood grade.
- 41 2. Size(s): As indicated on drawings.
- 42 3. Minimum Edge Radius: 1/2 inch.
- 43 E. Aggregate Base: 3/4" Minus crushed stone with fines
- 44 F. Clean Drainage Stone: 1" washed aggregate

PART 3 EXECUTION

3.1 EXAMINATION

- 49 A. Verify location of underground utilities and facilities in the playground area. Damage to underground utilities and facilities
- 50 will be repaired at Contractor's expense.
- 51 B. Verify that subgrades are at proper elevations and that smooth grading is complete.
- 52 C. Verify that proper depth of surfacing is marked on base supports of playground equipment.

3.2 PREPARATION

- 55 A. Correct subgrade irregularities to ensure that required depth of protective surfacing can be installed, and subgrade
- 56 elevation is in accordance with manufacturer's requirements.
- 57 B. Cover subgrade with geotextile fabric where noted on drawings and/or as recommended by surfacing manufacturer:
- 58 1. Verify that subgrade is free of ruts or protruding objects.

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- 2. Lap minimum 4 inches width at seams. Adhere seams in accordance with manufacturer's recommendations.
 - 3. Install fabric smooth, and free of tensile stresses, folds, or wrinkles.
 - 4. Protect fabric from clogging, tears, or other damage during surfacing installation.
 - 5. Repair or replace damaged fabric in accordance with manufacturer's recommendations.
- C. Remove rocks, debris, and other similar items.
 - D. Install containment curbs with top surface flush with intended elevation of top surface of protective surfacing.

3.3 AGGREGATE BASE

- A. Install aggregate base as indicated on drawings. Compact aggregate to maximum 95 percent, in accordance with ASTM D1557.
- B. Install with top surface of aggregate base no higher than grades and levels indicated and not more than 1/4 inch lower than grades and levels indicated.
- C. Install in true, even plane, sloped to provide positive drainage.
- D. Flatness Tolerance: 1/4 inch in 10 feet, maximum.

3.4 SYNTHETIC GRASS SYSTEM

- A. Install in accordance with CPSC Pub. No. 325, ASTM F1487, manufacturer's instructions, and requirements of authorities having jurisdiction.
- B. Securely install nailer boards in desired areas, making sure to keep the correct surface grade. Ensure that pad will sit flush with top of nailer board.
- C. Install pad underlayment system per manufacturer's instructions cutting to fit around equipment and other obstacles.
- D. Intall turf rolls as specified by product manufacturer taking care to neatly trim around equipment and other elements. Turf surface shall not be wrinkled and shall be attached to avoid sagging or shifting. Seam adjacent rolls per manufacturer's instructions using recommended products and methods.
- E. Neatly trim perimeters and secure per manufacturer's instructions
- F. Install infill material and broom to spread evenly per manufacturer's instructions.

3.5 LOOSE FILL SURFACING

- A. Install in accordance with CPSC Pub. No. 325 and ASTM F1487, and requirements of authorities having jurisdiction.
- B. Cover subgrade with geotextile fabric:
 - 1. Lap minimum 4 inches width at seams. Adhere seams in accordance with manufacturer's recommendations.
 - 2. Protect fabric from clogging, tears, or other damage during surfacing installation.
 - 3. Repair or replace damaged fabric in accordance with manufacturer's recommendations.
- C. Install loose fill to depths indicated, with smooth even surface flush with tops of containment curbs.

3.6 FIELD QUALITY CONTROL

- A. Obtain the services of the equipment manufacturer's field representative to review the finished installation for compliance with specified requirements and with design criteria to the extent known to the Contractor; submit report of field review.
- B. Repair or replace rejected work until compliance is achieved.

3.7 CLEANING AND PROTECTION

- A. Restore adjacent existing areas that have been damaged from the construction.
- B. Clean playground equipment of construction materials, dirt, stains, filings, and blemishes due to shipment or installation. Clean in accordance with manufacturer's instructions, using cleaning agents as recommended by manufacturer.
- C. Clean playground area of excess construction materials, debris, and waste.
- D. Remove excess and waste material and dispose of off-site in accordance with requirements of authorities having jurisdiction.
- E. Protect installed products until Substantial Completion.
- F. Replace damaged products before Substantial Completion.

END OF SECTION

SECTION 32 31 19
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Decorative aluminum fences.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2017.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- C. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016.

1.4 SUBMITTALS

- A. See Section 01 33 23 - Submittals, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
 - 2. Foundation details, concrete design mix and reinforcing schedule for anti-ram barrier system.
- D. Samples:
 - 1. Physical sample chain of manufacturer's standard finish options.
- E. Installer's Qualification Statement.
- F. Manufacturer's Warranty.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Finish: 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Decorative Metal Fences:
 - 1. Alumi-Guard; Flat Top, 3-Rail Ascot: www.alumi-guard.com/sle.
 - 2. Ameristar Perimeter Security, USA; Echelon II, 3-Rail Style Majestic: www.ameristarfence.com.
 - 3. Superior Aluminum Products, Inc; Series 7000, 3-Rail Style K: www.superioraluminum.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; , and having the following performance characteristics:

- 1 1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in
2 ASTM F2408.
- 3 B. Electro-Deposition Coating: Multi-stage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic
4 topcoat.
 - 5 1. Total Coating Thickness: 2 mils, minimum.
 - 6 2. Color: As selected by Architect from manufacturer's standard range.
- 7 C. Aluminum: ASTM B221.
 - 8 1. Tubular Pickets, Rails and Posts: 6005-T5 alloy.
 - 9 2. Extrusions for Posts and Rails (Outer Channel): 6005-T5 alloy.
 - 10 3. Extrusions for Pickets and Rail (Inner Slide Channels): 6063-T5 alloy.
- 11 D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.

2.3 ALUMINUM FENCE

- 14 A. Decorative Aluminum Fence System: Provide fence meeting requirements of ASTM F2408 for Industrial class.
 - 15 1. Post and Rails: Dimensions as indicated on drawings. Provide gates as required.
 - 16 2. Fence Panels: 6 feet high by custom length as indicated on drawings feet.
 - 17 a. Panel Style: Three rail.
 - 18 b. Panel Strength: Capable of supporting 270 pounds minimum load applied at midspan without deflection.
 - 19 c. Attach panels to posts with manufacturer's standard panel brackets and recommended fasteners.
 - 20 3. Posts: Aluminum extrusions; 2-1/2 inches square.
 - 21 a. Refer to structural drawings for anchorage. Posts supports embedded in concrete.
 - 22 4. Rails: Extruded aluminum channels.
 - 23 a. Double-walled aluminum U channel; outside cross-section dimensions of 1-3/4 inch square; interior guide
24 channel forms lower limit of raceway for retaining rod.
 - 25 b. Enclosed Retaining Rod: 0.125 inch diameter galvanized steel with variable pitch connection system for high
26 angle racking and elimination of external fasteners.
 - 27 c. Picket-to-Rail Intersection Seals: PVC grommets.
 - 28 d. Picket Spacing, Standard: 3-7/8 inch on center.
 - 29 5. Pickets: Extruded aluminum tubes.
 - 30 a. Size: 1 inch square.
 - 31 6. Fasteners: Manufacturer's standard stainless steel bolts, screws, and washers; factory finish fasteners to match
32 fence.
 - 33 7. Accessories: Aluminum castings, extrusions and cold-formed strips; factory finished to match fence.
 - 34 a. Flat post cap.
 - 35 b. Post base cover.
 - 36 8. Color: As selected by Architect from manufacturer's standard range.
- 37 B. Decorative Aluminum Post-and-Rail Fence and Swinging Gates:
 - 38 1. Style: Match aluminum fence style.
 - 39 2. Posts: Aluminum extrusions; 2 1/2 inch square.
 - 40 3. Color: As selected by Architect from manufacturer's standard range.
 - 41 4. Hardware: Refer to door schedule and hardware specifications.
 - 42 a. Coordinate electronic hardware within posts and rail for gate function.
 - 43 5. Products:
 - 44 a. Same as fence manufacturer..

PART 3 EXECUTION

3.1 EXAMINATION

- 49 A. Do not begin installation until substrates have been properly prepared.
- 50 B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before
51 proceeding.

3.2 INSTALLATION

- 54 A. Install in accordance with manufacturer's instructions.
- 55 B. Set fence posts in accordance with the manufacturer recommended spacing.
- 56 C. When cutting rails immediately seal the exposed surfaces by:
 - 57 1. Removing metal shavings from cut area.
 - 58 2. Apply zinc-rich primer to thoroughly cover cut edge and drilled hole; allow to dry.

- 1 3. Apply two coats of custom finish spray paint matching fence color.
2 4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.
3 D. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and
4 gate hardware selected.
5 1. Base type and quantity of gate hinges o the application; weight, height, and number of gate cycles.
6 2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
7 3. Provide gate hardware by the manufacturer of the gate and install in compliance with manufacturer's
8 recommendations.

9
10 **3.3 CLEANING**

- 11 A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove
12 excess material if required.
13 B. Clean fence with mild household detergent and clean water rinse well.
14 C. Touch up scratched surfaces using materials recommended by manufacturer. Match touchup paint color to fence finish.

15
16 **3.4 PROTECTION**

- 17 A. Protect installed products until completion of project.
18 B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

19
20 **END OF SECTION**

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