Special Provisions

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SPECIAL PROVISIONS

1. Administrative.

1-1 General.

Perform the work under this construction contract for City of Madison East-West Bus Rapid Transit (BRT), in Dane County, Wisconsin as the plans show and execute the work as specified in the State of Wisconsin, Department of Transportation, Standard Specifications for Highway and Structure Construction, 2022 Edition (Spec/standard specifications/standard spec), as published by Wisconsin Department of Transportation (WisDOT), the Construction and Materials Manual (CMM), as published by WisDOT, The Standard Detail Drawings (SDD), as published by WisDOT in Chapter 16 of the Facilities Development Manual (FDM), and these special provisions.

References within these special provisions regarding executing the work as specified in the City of Madison specifications, City specs, or similar language is used to refer to the City of Madison Standard Specifications for Public Works Construction 2022 Edition, as published by the City of Madison.

1-2 Scope of Work.

The work under this contract shall include, but is not limited to, construction of Bus Rapid Transit (BRT) platforms, canopies, the Junction Road Park and Ride, foundations for overhead bus chargers, buildings (restroom facilities and electrical facilities), concrete pavement, HMA pavement, pavement resurfacing, curb and gutter, sidewalk, curb ramps, concrete barrier, retaining walls, grading, stormwater ponds, landscaping, storm sewer, sanitary sewer, water, fiber optic, electrical, lighting, traffic signals, pavement marking, signs and all incidental items necessary to complete the work as shown on the plans and included in the proposal and contract.

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1-3 Scope of Work – Bid Alternate 1 - Snow Melt System

The City of Madison is taking a separate bid for the construction of the Snow Melt System as indicated on the bid forms, plans and in these special provisions. The City of Madison will make a determination to include this work with the awarded contract based on the resulting bids. The considerations for the alternatives are outlined in the instructions to bidders include in this contract.

1-4 Scope of Work – Bid Alternative 2 - Solar Panels

The City of Madison is taking a separate bid for the construction of the Solar Panels as indicated on the bid forms, plans and in these special provisions. The City of Madison will make a determination to include this work with the awarded contract based on the resulting bids. The considerations for the alternatives are outlined in the instructions to bidders include in this contract.

1-5 Notice to Contractor – City of Madison Metro Transit.

The City of Madison Metro Transit operates multiple bus routes within and directly adjacent to the construction limits. Coordinate with the Metro Transit to discuss the project schedule of operations including vehicular and pedestrian access during construction operations.

When construction operations at a specific site require the removal of an existing bus stop sign and/or shelter, Metro Transit will remove any existing Metro-owned bus stop sign and/or shelter before work begins. For bus stop signs, notify Metro Transit at least five business days prior to removal. For bus stop shelters, notify Metro Transit at least ten business days prior to removal. Upon completion of construction at a specific site, Metro Transit will re-install or replace bus stop signs and/or shelters as needed.

Metro Transit contacts:

Graham Carey
BRT Program Manager
415-937-3192
GCarey@cityofmadison.com

1-6 Notice to Contractor – Construction Management team.

The Construction Management team is representing Metro Transit during the construction process as the engineer. The engineer will be on-site during construction activities and will serve as the primary contact.

Construction Management team contact:

Monty Carlson
BRT Construction Project Manager
608-209-1562
mcarlson@hntb.com

1-7 Notice to Contractor – City of Madison.

The City of Madison has been made aware that the following work will be undertaken by others in approximately the same time frame and the same area as the proposed project. It shall be the contractor's responsibility to verify this information and any subsequent changes in the scheduling of the work by others and to make corrections in his/her construction timetable as required. The list below shall not be assumed to be a complete list of concurrent projects over the duration of this construction contract.

City of Madison Department of Transportation contacts:

Mike Cechvala
Deputy Project Manager
MCechvala@cityofmadison.com

Jim Wolfe
Engineering
608-266-4099
JWolfe@cityofmadison.com

Concurrent projects:

- East-West Bus Rapid Transit – Mineral Point Road Widened Sidewalk (This work will include the widened sidewalk on the north side of Mineral Point Road and associated curb ramps on the south side of Mineral Point Road. Construction is anticipated to occur from December 2023 through August 2024.)
- Mineral Point Road – USH 12 to S. High Point Road
- Madison Metro Route Redesign
- Madison Yards at Hill Farms Redevelopment (Projects 13494, 13495, 13496)
- City of Madison – Blair Street South Construction
- University Avenue Reconstruction (Shorewood Blvd. to University Bay)
- East Washington Avenue (WisDOT concrete pavement replacement project)
- East Washington Avenue (City of Madison asphalt pavement resurfacing)
- Sheboygan Avenue & Segoe Road (Utilities with Resurfacing)
- East Side Bike Improvements (East Washington Avenue near the Yahara River)
- Metro Transit Hanson Road Satellite Bus Facility Remodel
- US Highway 51 (Stoughton Road) NB Pavement Replacement (East Washington Avenue to Pierstorff Street)
- Alicia Ashman Pedestrian Bridge Painting (Over Campus Drive)
- University of Wisconsin Steam Tunnel Improvements (Near West Johnson Street and East Campus)
- State of Wisconsin DFD Utility Work (Engineering Drive, N. Randall Ave. and West Dayton St.)
- East Doty Street Reconstruction (Martin Luther King Jr. Blvd. to South Webster Street)
- East Wilson Street Reconstruction (Martin Luther King Jr. Blvd to South Butler Street)
- West Towne Path Construction (South Junction Rd. at Watts Rd. East to Plaza Dr.)
- 7601/7603 Mineral Point (project 13894)
- URP Element District Plat (Project 13355 - southwest corner of Mineral Point Rd & Whitney Way)
- CUNA Mutual Group– 5910 Mineral Point
- Oakwood 6145-6301 Mineral Point (Proposed project)
- 3005 University Ave (proposed project corner of University Avenue & Schmitt Place)
- 540 W Johnson St (302 N Bassett St) (Proposed Project 14038)
- 408 E Washington Avenue (Project 13433)
- 630 E Washington Avenue (Project 13993)
- 823 E Washington Avenue (Project 13275)
- 849 E Washington Avenue (Project 13769)
- 929 E Washington Avenue (901 E Wash) (Project 12309)
- 1118 E Washington Avenue (Project 14108)

- 1874 E Washington Avenue (Project 13771)
- 2521 E Washington Avenue (Project 13204)
- 322 E Washington Avenue (Proposed project 10-story building)
- 3100 E Washington Avenue (Proposed project 4-story residential building)
- 3401 E Washington Avenue (Proposed project multiuse site)
- 3602 E Washington Avenue (Proposed project carwash)
- University of Wisconsin – Madison School of Computer, Data & Information Sciences Building (University Avenue and West Johnson Street between North Orchard Street and North Charter Street)

1-8 Notice to Contractor – Real Estate.

Parcels for Transportation Project Plats 12777-1 & 12777-2 are anticipated to be acquired by January of 2024. Deadline for offer acceptance is by January 1, 2023. Parcels for Transportation Project Plat 12777-3 needed for traffic signal wood pole placement are anticipated to be acquired by March of 2023. All three plats to be provided to contractor at NTP. Fee areas and easements are shown on the Removal Plan sheets, Site Plan sheets and Grading Plan sheets.

1-9 Permits and Licensing.

Add the following to standard spec 107.3(1):

The City of Madison has obtained a City of Madison Erosion Control Permit and has submitted a DNR WRAPP Water Resources Application for Project Permit (formerly known as Notice of Intent (NOI) to obtain coverage under a Construction Site General Permit.

The contractor shall meet the conditions of the permit by properly installing and maintaining the erosion control measures shown on the plans, specified in the special provisions, or as directed by the engineer. This work will be paid for under the appropriate contract bid items or, if appropriate items are not included in the contract, shall be paid for as Extra Work. A copy of the permit is available at the City of Madison, Engineering Division office.

This permit covers trench dewatering to a maximum of 70 gallons/minute from the project, provided appropriate control measures are in place. The City's obtaining this permit is not intended to be exhaustive of all permits that may be required to be obtained by the contractor for construction of this project. It shall be the responsibility of the contractor to identify and obtain any other permits needed for construction.

2. Prosecution and Progress.

2-1 Prosecution and Progress.

Begin work within ten calendar days after Metro Transit issues a written notice to proceed. The notice to proceed is not expected prior to March 1, 2023.

Provide the start date to the engineer in writing within a month after executing the contract but at least fourteen calendar days before the Preconstruction Meeting. Upon approval, Metro Transit will issue the notice to proceed within ten calendar days before the approved start date.

To revise the start date, submit a written request to the engineer at least two weeks before the intended start date. Metro Transit will approve or deny that request based on the conditions cited in the request and its effect on City of Madison's scheduled resources.

The contract time for completion is based on an expedited work schedule and may require extraordinary forces and equipment. The proposed schedule of operations indicates that a large force and adequate equipment will be needed to assure that the work will be completed within the established contract time. The contractor shall use Oracle Primavera P6 scheduling software version 18 or higher and shall provide a monthly P6 cost-loaded schedule to the engineer for incorporation into the Project master schedule. The schedule shall be updated monthly showing critical path and the updates shall be tracked against the accepted baseline schedule.

Take care to protect all building faces and adjacent privately-owned structures from damage, dirt, undermining, and wet concrete. Place plywood, sheeting, or other approved shield against the building to protect it if approved by building owner. Excavate, bore, and drill adjacent to privately owned structures with caution to avoid undermining. The costs for this work are incidental to the contract. Return any privately-owned structures and building faces to its original condition if any damage or undermining, or both occur, or any dirt or concrete is adhered to the structure face.

The contractor shall limit work hours to 7:00 a.m. to 7 p.m. Monday-Saturday unless approved by the engineer in writing. The contractor will be able to start at 6:00 a.m. for concrete pours at building entrances and utility lateral connections if approved by the engineer. No work shall be allowed on holidays unless approved by the engineer.

City of Madison will not grant time extensions to the interim or completion dates for the following:

Severe weather as specified in standard spec 108.10.2.2.
Labor disputes that are not industry wide.
Delays in material deliveries.

Contractor shall not begin construction at a platform unless the construction of the platform and associated roadway pavement can be completed within 75 working days. The requirement applies to all contract work that is required to be performed within the footprint of a closed traffic lane or directly adjacent to it. Ensure that all contract work that is a potential cause for safety concerns as well as has the potential to disrupt the existing traffic flow is completed prior to completion of the platform and associated roadway pavement. This exemption does not relieve the contractor of performing the required contract work in timely fashion.

Short term lane closures may be approved for shelter, electrical, and finishing on the platforms after the 75-day period.

Construction Restrictions

Construct the BRT stations at Shorewood Boulevard, University Bay Drive, and the Bus/Bike Connector from Anderson Street to Mendota Street in 2024, unless approved by the engineer.

Complete construction of the East Campus Mall station, Park Street improvements, and Lake Street improvements between the Spring and Fall semesters, unless approved by the engineer.

Complete construction of the Orchard Street station between December 17, 2023 and May 4, 2024, unless approved by the engineer.

Obtain approval from the engineer prior to construction on State Street and Capitol Square. Coordinate construction schedule to avoid events in these areas.

Complete construction at the Junction Road Park and Ride, Sun Prairie Park and Ride and Hanson Road by May 2024.

Construction Testing Phase

Provide construction support for the 60-day construction testing phase, including providing modifications to previously constructed activities. This work to complete the modifications is incidental to the contract if modifications required are due to contractor or manufacturer deviances from the provided plans and specifications. Additional work identified from operational testing outside of construction work outlined within the plans and specifications, and not due to errors in construction, will be paid for accordingly. Payment shall be agreed upon by the contractor and Metro Transit prior to beginning any out of scope work.

Liquidated Damages

Complete all work as specified per standard spec 105.11.2.1.3 to reach substantial completion prior to Wednesday, August 1, 2024.

If the contractor fails to complete the work for the segments as listed below prior to 11:59 PM, July 31, 2024, the City of Madison will assess the contractor $4,300 in liquidated damages for each segment incomplete. If the work remains incomplete at 12:01 AM August 1, 2024, the City of Madison will assess the contractor $4,300 in liquidated damages for each segment for each day that requirements are not met after 12:01 AM August 1, 2024. Additional liquidated damages will be assessed under administrative item Failing to Open Road to Traffic.

Segment 1

Junction Road Park and Ride, Hanson Road Improvements, Metro Satellite Maintenance Facility, and Sun Prairie Park and Ride

Segment 2

All work from, and including, High Point Road to University Bay Drive.

Segment 3

All work from, and including, Campus Drive Roadway Improvements to Capitol Square.

Segment 4

All work from, and including, Blair Street to East Springs Drive.

If contract time expires prior to completion of all work specified in the contract, additional liquidated damages will be affixed according to standard spec 108.11.

Erosion Control Implementation and Enforcement

Submit a schedule and description of Clearing operations with the Erosion Control Implementation Plan (ECIP) fourteen days prior to any Clearing operations. The engineer will determine, based on schedule and scope of work, what additional erosion control measures shall be implemented prior to the start of Clearing operations, and list those additional measures in the ECIP.

Timely action regarding the maintenance of erosion control practices is critical to compliance with the City of Madison's land disturbance permits as issued by both the WDNR and the City of Madison. To allow the City to be assured of compliance with these permits, and federal, state and local laws, the contractor shall be required to proceed in the following manner with regard to the maintenance of these practices.

In the event an erosion control practice is determined by the engineer to require maintenance, or if the terms of the erosion control permit are not being met, the engineer shall order the contractor, in writing, to maintain the erosion control practice/device or comply with the terms of the permit. The contractor shall have 48 hours to complete that work and provide documentation to the engineer that it has been completed.

Failure to complete the work within the 48 hours shall result in any or all of the following actions by the engineer:

1) The contractor shall be charged one day of liquidated damages for failure to complete the work during the ordered timeframe and an additional day of liquidated damages for each 24 hour period that passes after the initial 48 hours during which time the ordered work is not completed.

2) At the engineer's discretion, the work ordered may be completed by City forces. In this case, the contractor shall be charged the liquidated damages as described in 1 above and shall be charged the full cost of City Forces responding to complete the ordered work.

3) At the engineer's discretion, work on the project as a whole may be suspended until such time as the contractor completes the originally ordered work. In this case, the contractor shall still be charged liquidated damages as described in 1 above. Additionally, days of work will continue to be charged during the suspension of work. If this results in the contractor failing to complete the project within the allotted contract time then additional liquidated damages shall be charged.

Environmental Protection

If construction activities beyond what was originally specified are required to complete the work, approval from the engineer, following coordination with the Wisconsin Department of Natural Resources as needed, is required prior to initiating activities.

Northern Long-eared Bat (Myotis septentrionalis)

Northern Long-eared Bats (NLEB) have the potential to inhabit the project limits because they roost in trees. Roosts have been identified within 150 feet of the project limits. The species and all active roosts are protected by the Federal Endangered Species Act. If an individual bat or active roost is encountered during construction operations, stop work and notify the engineer.

Ensure all operators, employees, and subcontractors working in areas of known or presumed bat habitat are aware of environmental commitments and avoidance and minimization measures (AMMs) to protect both bats and their habitat.

To avoid adverse impacts upon the NLEBs, no tree clearing is allowed between June 1 and July 31, both dates inclusive.

If the required tree clearing is not completed by May 31, the engineer will suspend all tree clearing and associated work directly impacted by clearing. The engineer will issue a notice to proceed with clearing and associated work directly impacted by clearing after consulting with the United States Fish and Wildlife Service (USFWS).

Tree clearing is limited to that which is specified in the plans. If additional trees need to be removed, no tree clearing shall occur without prior approval from the engineer. Notify the engineer if additional clearing cannot be avoided.

Submit a schedule and description of clearing operations with the ECIP fourteen days prior to any clearing operations. The engineer will determine, based on schedule and scope of work, what additional erosion control measures shall be implemented prior to the start of clearing operations, and list those additional measures in the ECIP.

Rusty Patch Bumble Bee *(Bombus affinis)*

The Rusty Patched Bumble Bee (Bombus affinis) is a federally-listed endangered species and a Wisconsin State Special Concern species. Suitable habitat for the rusty patched bumble bee consists of prairies, woodlands, marshes/wetlands, agricultural landscapes, and residential parks and gardens. Overwintering habitat includes non-compacted and often sandy soils or woodlands. The proposed park-and-ride site near the intersection of Mineral Point Road and Junction Road may contain suitable habitat for the rusty patched bumble bee. The DNR determined that the project may have an impact on the Rusty Patched Bumble Bee and that the impact is likely to be adverse.

Minimize potential impacts to federally-listed threatened and endangered species and Wisconsin State Special Concern species including the following:

- Perform work to minimize the spread of invasive species per standard spec 107.18 and to minimize soil compaction.
- Minimize soil disturbance and heavy equipment operation during overwintering October 15 to March 15.
- Minimize forest management that may destroy spring blooming flowers during their bloom periods.

Yellow Bumble Bee *(Bombus fervidus)*

The Yellow Bumble Bee (Bombus fervidus) is a Wisconsin State Special Concern species. The yellow bumble bee inhabits grassy, open areas including forest clearings, garden parks and along roadsides. The proposed Junction Road park-and-ride site may contain suitable habitat for the Yellow Bumble Bee. The DNR determined that the project may have an impact on the Yellow Bumble Bee; these impacts are not expected to be adverse.

Lake Sturgeon *(Acipenser fulvecens)*

Lake Sturgeon (Acipenser fulvescens) is a Wisconsin State Special Concern species. Lake Sturgeon is found in large rivers and lakes, along with shoal waters of the Great Lakes. The DNR determined that land disturbance activities during Project construction may have an impact on Lake Sturgeon; these impacts are not expected to be adverse.

Material and Equipment Staging

Submit a map that identifies all proposed material stockpile or equipment storage locations to the engineer fourteen days before either preconstruction or proposed use, whichever comes first. Identify the specific purposes for the location. Obtain written permits from the property owner and submit an electronic copy to the engineer before use. Do not stockpile or store materials or equipment on wetlands.

Material and equipment staging is available within the Brayton Parking Lot located at 1 South Butler Street so long as it does not conflict with the field office. Provide temporary fencing for public safety, incidental to the project. Include material and staging areas off the project limits in the ECIP for review.

2-2 Mobilization.

Add the following to standard spec 619.1:

Work under this contract will require multiple mobilizations to complete the work per the traffic control specifications and to meet the erosion control and phasing requirements of the project. All mobilizations, except for the provided quantity for mobilizations erosion control and mobilizations emergency erosion control, shall be considered incidental to this bid item.

2-3 Field Office Special, Item SPV.0105.002.

A Description

This special provision describes furnishing, equipping, and maintaining a field office facility.

B Materials

The Brayton Parking Lot located at 1 South Butler Street is available to the contractor to locate their field office facility in addition to material storage.

Obtain engineer approval before providing an existing office building, or an existing building converted to office-type use. Ensure that the building meets all applicable health, fire, and building codes and standards. Provide first aid kits, fire extinguishers, and all other supplies required to meet all applicable health, fire, and building codes and standards. The field office must be located less than one mile from the project limits.

Provide and maintain suitable interior or exterior lavatory facilities. Stock lavatory with sanitary supplies, including a sufficient supply of soap; hand sanitizer; toilet paper; and paper towels. The on-site lavatory facility must meet Federal, State, and local health department requirements at all times.

Equip the facility with suitable natural and light emitting diode (LED)DSL lighting. Also provide adequate heating and air conditioning equipment and fuel necessary to maintain a temperature range from 68 F to 80 F during the hours occupied.

Equip the facility with:

- Doors and windows with locks.
- Exterior doors with dead bolt locks.
- Windows with exterior screens to allow adequate ventilation.

Provide at least 1,000 square feet interior useable floor space, including shared spaces, such as plan review areas, conference rooms, storage areas, meeting areas, and hallways. Provide a minimum 150 square feet storage room with a lockable door and a shelving unit. Obtain engineer's approval of a suitably sized, open meeting area, including tables and folding chairs to accommodate regularly scheduled meetings of 30 people. Include a wireless ceiling mounted 1080-pixel liquid crystal display projector with a minimum of 3,000 lumens, 6' x 8' projector screen, a 4' x 8' white board with dry erase markers and erasers, and phone jack with phone service.

Provide 5 workstations. Workstations shall be a minimum 36 SF. Provide one ergonomically correct office chair in working condition, with, at a minimum, the following features, for each workstation:

- Five-legged base with casters.
- High backrest.
- Seat adjustable from 15 inches to 22 inches from the floor with a "seamless waterfall, rounded front edge.

For all work stations, provide unlimited high-speed internet service for exclusive department use via cable or DSL connection with a modem/router and capable of supporting cloud enabled file sharing, voice over internet protocol (VoIP), video conferencing, and web-based applications. Ensure that system meets the following:

- Includes a wireless network for the field office.
- Can accommodate IPSec based VPN products.
- Has a broadband bandwidth range with minimum connection speed of 200 Mbps + 1/2 Mbps per user download and 20 Mbps upload.
- Must allow users to connect concurrently.

Provide and maintain a Windows 10 compliant multi-function device with copy, print, and scan capabilities that can accommodate both 8 1/2" x 11" and 11" x 17" paper. Replenish paper, toner cartridges, and other supplies before fully expended. Ensure that department staff can connect to the device either directly or through the field office wireless network.

Maintain the field office equipment and provide supplies for the photocopiers as requested by the engineer.

Provide and maintain an adequate supply of bottled drinking water. Provide one refrigerator with a minimum 18 cubic foot capacity, including a freezer. Provide one microwave oven with a minimum 1.1 cubic foot capacity, a minimum of 1000 watts, and a removable glass turntable.

Provide for the professional cleaning of the field office during regular business hours once per week.

Provide clearly marked recycling and waste receptacles within the field office, and separate recycling and waste dumpsters near the field office. Cover outdoor containers to keep out rain, and snow. Provide regularly scheduled recycling and waste pick-up.

Maintain 2 parking stalls for City of Madison and construction management staff. Maintain the parking lot and egress, including snow removal.

C Construction

Do not combine field offices, or combine them with, or attach them to, any buildings used by the contractor, unless the engineer allows in writing.

Do not begin construction operations requiring the use of the field offices by the City of Madison staff until the required field offices are approved by the engineer, furnished, fully equipped, and made ready for use as the engineer directs.

The field office shall remain available for the City of Madison staff until the engineer approves its closure. Upon contract completion these facilities remain the contractor's property.

D Measurement

The City of Madison will measure Field Office Special as a single lump sum unit of work, completed in accordance to the contract and accepted.

E Payment

The department will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.002	Field Office Special	LS

Payment is full compensation for providing, equipping, securing, cleaning and maintaining the facility and associated parking lot; for telecommunications equipment, installation, and service fees; and for providing all incidentals, including bottled water, refrigerator/freezers, microwaves, utilities, fuel, safety, ventilation, lavatory facilities, and office supplies as required.

2-4 Contractor Document Submittal.

This special provision describes minimum requirements for submitting project documents to the engineer. This special provision does not apply to shop drawing submittals.

Provide one electronic copy of all documents requiring the engineer review, acceptance, or approval. Attach a completed engineer-provided transmittal sheet to each email submittal. The engineer will reject submittals with incomplete transmittal sheets and require resubmittal.

The engineer will return one reviewed, accepted, or approved original to the contractor. Additional return originals can be requested. Submit an additional original for each additional return original requested.

Submit electronic copies in Portable Document Format (PDF) to the engineer-designated folder within the engineer's SharePoint site and send alerts with a link to the document via email to (an) account(s) the engineer determines. If possible, translate original documents from their native format (e.g. Word, Excel, AutoCAD, etc.) using a Portable Document Format translation routine. Scan other documents to PDF format with a minimum resolution of 600 dpi.

All costs for contractor document submittals are incidental to the contract.

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2-5 City of Madison Parks Division Coordination.

When construction activities at a specific site may impact City of Madison Parks, notify the engineer and City of Madison Parks Division at least fourteen days prior to construction.

City of Madison Parks Division contact:

Eric Knepp
Superintendent
608-266-4711
EKnepp@cityofmadison.com

2-6 University of Wisconsin-Madison Coordination.

When construction activities at a specific site may impact University of Madison-Wisconsin, notify the engineer and University of Madison-Wisconsin at least fourteen days prior to construction.

University of Madison-Wisconsin contact:

Gabe Mendez
Director of Transportation Operations
608-890-3268
gabe.mendez@wisc.edu

2-7 Madison College Coordination.

When construction activities at a specific site may impact Madison College, notify the engineer and Madison College at least fourteen days prior to construction.

Madison College contact:

Fred Brechlin
Director Planning and Construction Management
608-246-6837 Office
608-576-1352 Cell
fbrechlin@madisoncollege.edu

2-8 Madison Metropolitan School District Coordination.

When construction activities at a specific site may impact Madison Metropolitan School District, notify the engineer and Madison Metropolitan School District at least fourteen days prior to construction.

Madison Metropolitan School District contact:

Michael LaCount, mlacount@madison.k12.wi.us
De'Kendrea Stamps, dbstamps@madison.k12.wi.us
Mick Howan, School District Transportation, mjhowan@madison.k12.wi.us
Jeff Fedler, Madison School District Transportation Coordinator, jfedler@madison.k12.wi.us

2-9 Capitol Square Coordination.

Construction on or near Capitol Square shall be completed by the contractor to minimize impacts to businesses and events.

When construction activities at a specific site may impact the Capitol Square, notify the engineer and Kelly Post at least fourteen days prior to construction.

Capitol Square contact:

Kelly Post
Interim Community Events Coordinator
608-264-9289
KPost@cityofmadison.com

2-10 Railroad Insurance and Coordination - Wisconsin and Southern Railroad Company.

A. Description

Comply with standard spec 107.17 for all work affecting Wisconsin and Southern Railroad Company property and any existing tracks.

A.1 Railroad Insurance Requirements

In addition to standard spec 107.26, provide railroad protective liability insurance coverage as specified in standard spec 107.17.3. Insurance is filed in the name of Wisconsin and Southern Railroad Company.

Notify evidence of the required coverage, and duration to Amanda Haggerty, Office Administrator; 1890 E Johnson Street, Madison, WI 53704; Telephone (608) 620-2048; E-mail: ahaggerty@watcocompanies.com.

Also send a copy to the following: Teri Beckman, SW Madison Region Railroad Coordinator; 2101 Wright Street, Madison, WI 53704; Telephone (608) 733-1923; E-mail: teri.beckman@dot.wi.gov

Include the following information on the insurance document:

- Project ID: 13925
- Work Performed: Construct BRT platform and canopy, reconstruct pavement and sidewalk, pavement marking, and signing

#	Route Name	City/County	Crossing ID	RR Subdivision	RR Milepost
1	Randall Ave.	Madison, Dane County	391728A	Prairie	139.72
2	East Washington Ave./US 151	Madison, Dane County	177313F	Cottage Grove	80.82
3	East Washington Ave./US 151	Madison, Dane County	177841G	Reedsburg	139.58

A.2 Train Operation

#	Passenger Train Volume	Passenger Train Speed	Freight Train Volume	Freight Train Speed	Frequency	Switch Train Comment*
1	0	0	1	5 mph to 10 mph	Daily	There are switch trains in addition to through trains
2	0	0	0	5 mph to 20 mph	Daily	There are switch trains in addition to through trains
3	0	0	6	5 mph to 20 mph	Daily	No switch trains

* Switch trains are in addition to freight and passenger trains.

A.3 Names and Addresses of Railroad Representatives for Consultation and Coordination

Construction Contact

Todd Mulrooney, Superintendent of Engineering, Wisconsin and Southern Railroad Co.; 1890 East Johnson Street, Madison, WI 53704; Telephone (608) 620-2045; E-mail tmulrooney@watco.com for consultation on railroad requirements during construction.

Amend standard spec 108.4 to include the railroad in the distribution of the initial bar chart, and monthly schedule updates. The bar chart shall specifically show work involving coordination with the railroad.

Flagging Contact

See Construction Contact. Reference the Crossing ID, Wisconsin Milepost and Subdivision found in A.1.

Cable Locate Contact

In addition to contacting Diggers Hotline, contact the Construction Contact at least five working days before the locate is needed. Reference the Crossing ID, Wisconsin Milepost and Subdivision found in A.1.

WSOR will only locate railroad owned facilities located in the railroad right-of-way. The railroad does not locate any other utilities.

A.4 Work by Railroad

The railroad will perform the work described in this section, except for work described in other special provisions and will be accomplished without cost to the contractor. None.

A.5 Temporary Grade Crossing

If a temporary grade crossing is desired, submit a written request to the railroad representative named in A.3 at least 40 days prior to the time needed. Approval is subject to the discretion of the railroad. The City of Madison has made no arrangements for a temporary grade crossing.

A.6 Temporary Clearances During Construction

Construction Contact

Chris T. Keckeisen, Manager Special Projects - Industry & Public Projects Engineering Department; 1400 Douglas, MS 0910, Omaha, NE, 68179; Telephone (402) 5445131; E-mail ctkeckei@up.com or Richard Ellison, Project coordinator, 207 Powell Avenue, Labadie, MO, 63055; Telephone (847) 323-7197; E-mail richardellison@up.com for consultation on railroad requirements during construction.

Amend standard spec 108.4 to include the railroad in the distribution of the initial bar chart, and monthly schedule updates. The bar chart shall specifically show work involving coordination with the railroad.

Flagging Contact

See Construction Contact. If more than 30 days of flagging is required contact UP 30 days prior to needing a flagger on site. Reference the Wisconsin Milepost and Subdivision located in A.1.

Cable Locate Contact

In addition to contacting Diggers Hotline, contact the UP Call Before You Dig line at (800) 336-9193 at least five working days before the locate is needed. Normal business hours are 6:30 AM to 6:30 PM, Central Time, Monday through Friday, except holidays and are subject to change. Calls will be routed at all times in case of an emergency. Reference the Wisconsin Milepost and Subdivision located in A.1.

UP will only locate railroad owned cable buried in the railroad right-of-way. The railroad does not locate any other utilities.

B Railroad Flagging

Arrange with the railroad for the flagging of trains and safety of railroad operations if clearances specified in subsection 107.17.1 are not maintained during construction operations. At any other time in railroad representative's judgment, the contractor's work or operations constitute an intrusion into the track zone and create an extraordinary hazard to railroad traffic, and at any other time when flagging protection is necessary for safety to comply with the operating rules of the railroad.

Projects with concurrent activity may require more than one flagger.

Projects with heavy contractor activity within 25 feet of the centerline of any track or unusual or heavy impact on railroad facilities will normally require a full-time flagger.

The City of Madison and railroad will monitor operations for compliance with the above flagging requirements. Violations may result in removal from railroad property until arrangements to adhere to the flagging requirements are satisfied. If the railroad imposes additional flagging requirements beyond the above flagging requirements due to the previous violations, the contractor shall bear all costs of the additional flagging requirements.

C Flagging by Railroad– Railroad Does Not Pay Flagging Costs

C.1 General

Replace paragraph (1,3 and 4) of standard spec 107.17.1 with the following:

(1) Coordinate with the railroad for all work performed within 25 feet of the track centerline including equipment or extensions of equipment that can fall within 25 feet of the track centerline or adjacent facilities or when working on railroad right-of-way. Include the following on all submittals and other written communications with the railroad:

- WisDOT crossing number.
- Railroad milepost.
- Railroad subdivision.

(3) Perform all work within 25 feet of the track centerline including equipment or extensions of equipment that can fall within 25 feet of the track centerline or adjacent facilities or when working on railroad right-of-way in a way that does not interfere with the safe and uninterrupted operation of railroad traffic. Maintain clearances during construction as follows:

1. Do not operate equipment closer than 25 feet horizontally from a track centerline or 22 feet vertically above the top of a rail, except under the protection of railroad flaggers.

2. Do not store materials or equipment closer than 25 feet horizontally from a track centerline.

3. Provide an obstruction-free work zone adjacent to a track extending 12 feet or more horizontally on both sides of the track centerline. Keep this work zone free of construction debris.

4. Unless the railroad's chief engineering officer approves otherwise in writing, maintain minimum clearances from falsework, forms, shoring, and other temporary fixed objects as follows:

4.1 Provide 12 feet, plus 1.5 inches per degree of track curvature, measured horizontally from the track centerline.

4.2 Provide 21 feet, plus compensation for super-elevated track, measured vertically above the top of the highest rail.

(4) Comply with the railroad's rules and regulations when work is within 25 feet of the track centerline including equipment or extensions of equipment that can fall within 25 feet of the track centerline or adjacent facilities or when working on railroad right-of-way. If the railroad's chief engineering officer requires, arrange with the railroad to obtain the services of qualified railroad employees to protect railroad traffic through the work area. Bear the cost of these services and make payment directly to the railroad. Notify the appropriate railroad representative as listed in section A.3 above, in writing, at least 40 business days before starting work near a track. Provide the specific time planned to start the operations.

C.2 Rates - Wisconsin and Southern Railroad Company

The following rates, reimbursement provisions, and excluded conditions will be used to determine the contractor's cost of flagging:

- $106 per hour with a four-hour minimum up to eight hours in any weekday (including wages, labor surcharges, meals, lodging, vehicle and mileage expenses),
- $151 per hour for all hours over eight in any weekday (including wages, labor surcharges, meals, lodging, vehicle and mileage expenses),
- $190 per hour with a four-hour minimum up to eight hours on Saturday's (including wages, labor surcharges, meals, lodging, vehicle and mileage expenses),
- $190 per hour for all hours over eight on Saturday's or up to eight hours on Sunday's or holidays (including wages, labor surcharges, meal, lodging, vehicle and mileage expenses)

C.3 Reimbursement Provisions

The actual cost for flagging will be billed by the railroad. After the completion of the work requiring flagging protection as provided in section B above, the City of Madison will reimburse 50% of the cost of such services up to the rates provided above based on paid railroad invoices, except for the excluded conditions enumerated below. In the event actual flagging rates exceed the rates stated above, the City of Madison will reimburse 100% of the portion of the rate that is greater than the rates stated above.

C.4 Excluded Conditions

The City of Madison will not reimburse any of the cost for additional flagging attributable to the following:

1. Additional flagging requirements imposed by the railroad beyond the flagging requirements provided in subsection B above due to violations by the contractor.
2. Temporary construction crossings arranged for by the contractor.

The contractor shall bear all costs of the additional flagging requirements for the excluded conditions.

C.5 Payment for Flagging

The City of Madison will pay for the City of Madison's portion of flagging reimbursement as specified in section C of this provision under the following item:

ITEM NUMBER	DESCRIPTION	UNIT
801.0117	Railroad Flagging Reimbursement	DOL

The reimbursement payment, as shown on the Schedule of Items, is solely for City of Madison accounting purposes. Actual flagging costs will vary based on the contractor's means and methods.

Railroads may issue progressive invoices. Notify the railroad when the work is completed and request a final invoice from the railroad. Promptly pay railroad-flagging invoices, less any charges that may be in dispute. The City of Madison will withhold flagging reimbursement until any disputed charges are resolved and the final invoice is paid. No reimbursement for flagging will be made by the City of Madison if a violation of subsection B is documented.

stp-107-034 (20220107)

3. Meetings.

3-1 Pre-Bid Meeting.

Add the following to standard spec 102.3.1:

Prospective bidders may attend a virtual pre-bid meeting. Details and directions regarding an invitation for prequalified bidders will be forthcoming.

No meeting minutes will be prepared. Issues discovered at the meeting will be handled by addendum.

stp-102-010 (20150630)

3-2 Preconstruction Meeting.

Before any work at the site is started, a meeting attended by City of Madison, contractor, engineer, appropriate utility companies, and others as appropriate will be held to establish understanding among the parties as to the work, schedule, handling of submittals, payment, and required records associated with this project. Contractor shall setup the meeting and send out invites, including sending an invite list to the engineer.

3-3 Coordinate with Businesses and Residents.

The contractor shall arrange and conduct meetings with City officials, business owners, property owners, residents, Madison Central Business Improvement District (Tiffany Kenney, 608-512-1340, director@visitdowntownmadison.com), and the Greater State Street Business Association (Elizabeth Ganser, 608-239-4133, Elizabeth@fontanasports.com) to discuss the project schedule of operations including vehicular and pedestrian access during construction operations, anticipated utility outages, and any other vital information as determined by the contractor and engineer. The contractor shall hold up to 6 public meetings, including a first meeting at least one week prior to the start of work in 2023 and a meeting at least one week prior to the start of work in 2024. No further meetings are anticipated to be required unless directed by engineer. The contractor shall arrange for a suitable location for meetings that provides reasonable accommodation for public involvement. City of Madison will prepare and coordinate publication of the meeting notices and mailings for meetings. The contractor shall schedule meetings with at least 2 weeks prior notice to the engineer to allow for these notifications.

stp-108-060 (20141107)

At least 48-hours in advanced of disturbing areas the contractor shall coordinate with businesses and residents on privately owned items such as landscaping items that are within the construction area.

Contractor shall abide by section 107.11.1(1) of the standard specifications regarding continuing property owner coordination required throughout the duration of the project.

3-4 Coordinate with Suppliers.

The contractor shall coordinate with suppliers who will install items listed to be installed “by others.” This includes, but is not limited to, ticket vending machines, Real-time signs with ADA button, public address system, transit map sign, cameras, Transit Signal Priority and vehicle chargers. Contact information will be provided by the engineer upon request by the contractor when suppliers are identified for the “by others” items.

4. Environmental.

4-1 Information to Bidders, WPDES General Construction Storm Water Discharge Permit.

The City of Madison is working to obtain coverage through the Wisconsin Department of Natural Resources to discharge storm water associated with land disturbing construction activities of this contract under the Wisconsin Pollutant Discharge Elimination System General Construction Storm Water Discharge Permit

(WPDES Permit No. WI-S066796-1). A certificate of permit coverage will be available from the engineer. Contact the engineer for contact information. Post the permit in a conspicuous place at the construction site.

stp-107-056 (20180628)

4-2 Noxious Weeds.

The contractor shall perform all work in accordance with Wisconsin Statute 66.0407 to minimize the spread of noxious weeds within project limits.

4-3 Hazardous Materials.

Contractor shall not store construction materials and debris, including fuels, oil, and other liquid substances, in a manner that would allow them to enter a wetland, waterbody, or groundwater source as a result of spillage, natural runoff, or flooding. If a spill of any potential pollutant should occur, it is responsibility of the contractor to remove such material, minimize any contamination resulting from the spill, and immediately notify the engineer.

4-4 Excavation, Hauling, Segregation, and Disposal of Contaminated Soil, Item SPV.0035.002

A Description

This special provision describes management of nonhazardous contaminated soils or excavated fill material if encountered within the project limits. Nonhazardous contaminated soil and fill material shall be disposed at a licensed landfill facility.

Perform this work according to standard spec 205 and with pertinent parts of Chapters NR 700-754 of the Wisconsin Administrative Code, as supplemented herein. Per NR 718.07, a solid waste collection and transportation service- operating license is required under NR 502.06 for each vehicle used to transport contaminated soil.

A.1 Notice to Contractor- Contaminated Soil and Groundwater Beyond Construction Limits

Based on results from the Phase 1 Hazardous Materials Assessment, sites with known or suspected soil contamination were identified adjacent to the construction limits where grading or excavation may be required. Documented soil contamination is present beyond the project construction limits; however, there is potential for soil contamination or fill material within this project where excavation may be required at the following locations:

Site 62W-	Shorewood Skelly Service, 3300 University Ave, Station 335+50 to 336+50 LT
Site 63W-	Century House, 3033 University Avenue/ 725 Hill St, Station 336+50 to 337+50 RT
Site 66W-	Rays Texaco, Pickett's 76 Service, 2635 University Avenue, Station 363+50 to 365+00 RT
Site 67W-	Former Service Station, 2638 University Avenue, Station 363+25 to Station 363+60 LT
Site 68W-	Import Auto Clinic Inc, Aimers Arco Inc, 2583 And 2585 University Ave, Station 370+00 RT
Site 69W-	Former Service Station, 2601 University Ave, Station 369+25 to Station 369+50 RT
Site 72W-	Wisconsin Energy Institute, UW Madison University Health Services, 1552 University Avenue, Station 415+10 to Station 419+25 RT
Site 79W-	UW Madison Vivarium, N Orchard St & Campus Dr/ 311 N Orchard, Station 210+25 LT
Site 86W-	Chazen Museum Expansion Construction Site, 800 University Ave, Station 833+75 to Station 836+25 LT
Site 92E-	North Square Association, 24 E Mifflin St (Readdressed to 44 E Mifflin), Station 407+00 SQN LT
Site 99E-	Klinke Cleaners-Capital, Klinke Cleaners Madison Steam Dye, 412 East Washington Avenue, Station 213+00 WA LT
Site 101E-	Madison Chiropractic Association (Denzer Fay), 521 E Washington Ave, Station 215+75 to Station 216+10 WA RT
Site 101AE-	Former Fill Station- S Blair Street, 520 E Washington Ave, Station 216+00 to Station 216+50 WA LT

Site 103E- Galaxie Condominium, 800 block of Washington Ave/ 811 E Mifflin St, Station 230+00 WA LT

Site 104E- Current Galaxie Condo Owners- Former John Nottoli, Hertz Car Sales, F & F Tire Service Inc, Park Street Arco, 850-854 E Washington Ave, Station 235+75 to Station 236+00 WA LT

Site 106(A)E- Humiston Keeling Company, 849 E Washington Ave, Station 235+50 to Station 236+10 WA RT

Site 106(B)E- Lussier Teen Center, Centers For Prevention & Intervention, Former Savidusky Furriers And Cleaners, 827 E Washington Ave, Station 233+50 RT

Site 107E- Breese Stevens Field E Wash Ave Row, 902 E Washington Ave, Station 241+75 to 243+00 LT

Site 121E- Car Care Clinic, Tune-Up Clinic, Phillips 66, Prairie Fire Bio Fuels Shop, 1894 E Washington Ave, Station 287+25 to Station 287+75 WA LT

Site 133E- Amoco Oil Co./Ss #15389, Marges Food Shops, Saterns Pump & Wash, 2602 E Washington Ave, Station 330+11 to 330+50 WA LT

Site 135E- Marathon Station, Total Petroleum, Total Mart, Marathon Sta (Former), 2601 East Washington Ave, Station 329+80 to Station 331+25 WA RT

Site 138E- Krishnaiah Properties, 3003-3015 E Washington Ave, Station 350+00 WA RT

Site 139E- Mobil Oil Corp, Mobil #05-Egn, Stieves Service Inc, 3019 E Washington Ave, Station 352+40 to Station 352+75 WA RT

Site 143E- Olberg Inc, 3375 East Washington, Station 395+55 to Station 396+25 WA RT

If contaminated soil, groundwater, solid waste fill material (e.g. cinders, ash, foundry sand, etc) or underground storage tanks (USTs) are encountered within the areas listed above or elsewhere on the project, then terminate excavation or grading in the area and notify the engineer.

B (Vacant)

C Construction

C.1 Coordination

Coordinate this work with the engineer or their designated environmental consultant. The role of the environmental consultant will be limited to:

1. Determining the locations and limits of contaminated soil to be excavated based on soil analytical results from previous investigations, visual observations, and field screening of soil that is excavated;
2. Identifying contaminated soils to be hauled to the landfill facility;
3. Documenting that activities associated with management of contaminated soils are in conformance with the contaminated soil management methods for this project as specified herein; and
4. Obtaining the necessary approvals for disposal of contaminated soil.

The contractor shall provide at least a 14-calendar day notice of the preconstruction conference date to the environmental consultant. At the preconstruction conference, provide a schedule for all excavation activities in the contaminated areas specified above to the environmental consultant. Identify the WDNR approved landfill facility that will be used for disposal of contaminated soils. Provide this information to the environmental consultant no later than 30 calendar days prior to commencement of excavation in the contaminated areas, or at the preconstruction conference, whichever comes first.

The contractor shall coordinate with the environmental consultant to ensure that the environmental consultant is present during excavation in the contaminated areas. Notify the environmental consultant at least three working days prior to commencement of excavation activities in the contaminated areas. Perform excavation work in this area on a continuous basis until excavation work is completed. The environmental consultant will be responsible for obtaining the necessary approvals for disposal of contaminated soils. Do not transport contaminated soil offsite without prior approval from the environmental consultant.

Active groundwater monitoring wells are not expected to be located within the project limits. If active groundwater monitoring wells are encountered during construction, notify the engineer and protect the wells

to maintain their integrity. The environmental consultant will determine if monitoring wells need to be maintained. Adjust monitoring wells that need to be maintained and do not conflict with structures or curb and gutter to be flush with the final grade. Coordinate with the environmental consultant the abandonment or adjustment of wells that conflict with the previously mentioned items and wells that are not required to be maintained.

For further information regarding previous investigation and remediation activities at these sites contact the engineer.

C.2 Health and Safety Requirements

Supplement standard spec 107.1 with the following:

During excavation activities of contaminated soil, site workers taking part in these activities that will result in the reasonable probability of exposure to safety and health hazards associated with potential hazardous materials shall have completed health and safety training that meets the Occupational Safety and Health Administration (OSHA) requirements for Hazardous Waste Operations and Emergency Response (HAZWOPER), as provided in 29 CFR 1910.120.

C.3 General Conditions

Supplement standard spec 205.3 with the following:

Control operations in the contaminated areas to minimize the quantity of contaminated soil excavated.

The engineer or their environmental consultant will periodically evaluate soil excavated from the contaminated areas. The environmental consultant will evaluate excavated soil based on field-screening results, visual observations, and soil analytical results from previous environmental investigations. Assist the environmental consultant in collecting soil samples for evaluation using excavation equipment. The sampling frequency shall be a maximum of one sample for every 15 cubic yards excavated.

Based on the results of such field-screening, the material will be designated as follows:

1. Excavation Common consisting of clean soil and/or clean construction and demolition fill (such as clean soil, boulders, concrete, reinforced concrete, bituminous pavement, bricks, building stone, and unpainted or untreated wood), which under NR 500.08 are exempt materials, or
2. Contaminated soil for disposal at the WDNR-licensed landfill facility, or
3. Potentially contaminated material for temporary stockpiling and additional characterization prior to disposal.

Some material may require additional characterization prior to disposal. Provide for the temporary stockpiling of up to 50 cubic yards of contaminated material on-site that require additional characterization. Construct and maintain a temporary stockpile of the material according to NR 718.05(3), including, but not limited to, placement of the contaminated soil on an impervious surface and covering the stockpile with impervious material to prevent infiltration of precipitation.

The environmental consultant will collect representative samples of the stockpiled material, laboratory analyze the samples, and advise the contractor, within 10 business days of the construction of the stockpile, of disposal requirements. The stockpiled material shall be disposed either at the WDNR licensed landfill facility by the contractor or, if characterized as hazardous waste, by others.

As an alternative to temporarily stockpiling contaminated material that requires additional characterization, the contractor has the option of suspending excavation in those areas where such material is encountered until such time as characterization is completed. Directly load and haul soils designated by the environmental consultant for offsite treatment and disposal at the WDNR-licensed facility. Use loading and hauling practices that are appropriate to prevent any spills or releases of contaminated soils or residues. Prior to transport, sufficiently dewater soils designated for off-site treatment and disposal so as not to contain free liquids.

D Measurement

The City of Madison will measure Excavation, Hauling, Segregation, and Disposal of Contaminated Soil in tons of contaminated soil accepted by the landfill facility as documented by weight tickets generated by the landfill facility. The management of contaminated groundwater shall be considered incidental to other items in the contract.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0035.002	Excavation, Hauling, Segregation, and Disposal of Contaminated Soil	TON

Payment is full compensation for excavating, segregating, loading, hauling, and direct landfilling of contaminated soil; obtaining solid waste collection and transportation service operating licenses; assisting in the collection of soil samples for field evaluation; and dewatering of soils prior to transport, if necessary. Payment includes the landfill tipping fees for the disposal of contaminated soil.

4-5 Archaeological and Historical Findings.

Contractor shall abide by standard spec 107.25 regarding archaeological and historical findings. If at any point project activities should result in the inadvertent discovery of human remains or burials, all activities in the area of the discovery should be halted and the area of the discovery fenced and secured. The local Sherriff's Department and the Wisconsin Historical Society should be immediately notified in compliance with Wisconsin burial sites protection laws (Wisconsin State Statute 157.70 and Wisconsin Administrative Code HS 2).

In accordance with Wisconsin's burial sites law, Wisconsin State Statute §157.70, monitoring by a qualified archaeologist is required if ground disturbing construction activities occur within the following sites:

- 47DA0136/BDA0389 (Monona Avenue Park Mound Group)
- 47DA0177/BDA0586 (Capitol Park Effigy)

Ground disturbance is not anticipated at these sites. Archaeological monitoring will not be required if ground disturbance will not occur within the reported boundary of either site.

4-6 Noise Control.

Construction noise shall comply with City of Madison noise ordinance. Contractor shall prepare a detailed noise control plan under the supervision of a noise control engineer or acoustician. Key elements of a plan include:

- Contractor's specific equipment types
- Schedule and methods of construction
- Maximum noise limits for each piece of equipment with certification testing
- Prohibitions on certain types of equipment and processes during the nighttime hours without variances
- Identification of specific sensitive sites where near construction sites
- Methods for projecting construction noise levels
- Implementation of noise control measures where appropriate
- Acoustic shielding requirements for jackhammers, chainsaws, and pavement breakers
- Methods for responding to community complaints
- Methods to limit vibrations in construction areas within 36 feet of a building

Plan shall be submitted to the engineer for approval prior to construction. The noise control plan is incidental to construction.

5. Traffic Control.

5-1 General

This work includes furnishing, constructing, assembling, hauling, erecting, re-erecting, maintaining, restoring, and removing non-permanent traffic signs, drums, barricades, and similar control devices, including arrow boards, for providing, placing, and maintaining work zones. Maintaining shall include replacing damaged or stolen traffic control devices. Existing traffic control devices such as signs and pavement markings that conflict with the Maintenance of Traffic Control Plan shall be removed or covered as directed by the engineer.

All signing and barricading shall conform to Part VI of the Federal Highway Administration's latest "Manual on Uniform Traffic Control Devices" (MUTCD), the State of Wisconsin Standard Facilities Development

Manual (including Chapter 16 – Standard Detail Drawings, Series 15 – R/W, Access Control and Traffic Control) and the City of Madison Standards for sidewalk and bikeway closures.

The contractor shall submit a Traffic Control Plan, including all necessary phases, to Tom Mohr, 608-267-8725, tmohr@cityofmadison.com and Chad Veinot, 608-267-1960, cveinot@cityofmadison.com , prior to the pre-construction meeting. The Traffic Control Plan shall address all requirements of this section of the special provisions. The successful bidder shall work with the City Traffic Engineering Division to develop an approved Traffic Control Plan. The contractor shall not start construction on this project until the Traffic Engineering Division has approved a traffic control plan and traffic control devices have been installed, in accordance with the approved plan. Request and receive closure approval through the Wisconsin Lane Closure System (WisLCS), https://transportal.cee.wisc.edu/closures a minimum of 7 calendar days prior to the lane closure, partial street closure, or start of each new construction stage or phase along East Washington Avenue. The contractor shall notify provide the project engineer the approval prior to a land closure, partial street closure, or start of a new construction stage for phase along East Washington. Failure of the contractor to obtain approval of a Traffic Control Plan or closure, as specified above, may prevent the contractor from starting work or implementing a lane or street closure and shall be considered a delay of the project, caused by the contractor.

The contractor shall refer to Chapter 6 in the MUTCD to provide adequate signs and taper lengths. The contractor may use drums as a channelizing device to separate traffic from the work zone. Type A warning lights shall be installed on all barricades used in the project per State of Wisconsin S.D.D. 15C2-B. Contractor shall also place Type C warning lights on any traffic control drums used to taper traffic or lane closures.

The contractor shall be responsible for installing and maintaining traffic control in accordance with the approved Traffic Control Plan and as directed by the engineer. The traffic control plan may need to be altered as conditions change in the field or as unexpected conditions occur. This shall include relocating existing traffic control or providing additional traffic control. The contractor shall install and maintain any necessary modifications or additions to the traffic control, as directed by the engineer, at no cost to the City. Provide 24 hours-a-day availability of equipment and forces to expeditiously restore lights, signs, or other traffic control devices that are damaged or disturbed. The contractor shall also supply the name and telephone number of the local contact person for traffic control repairs before starting work. The turning of traffic control devices when not in use to obscure the message will not be allowed under this contract.

The contractor shall furnish portable changeable message signs and temporary stop signs at locations where the existing traffic signal cabinet is being replaced with a new traffic signal cabinet. Refer to the plans in Set #3 for locations where these improvements are proposed. The contractor shall request message approval from the engineer. A request does not constitute approval.

Do not park or store equipment, vehicles, or construction materials within the clear zone on any roadway carrying traffic during non-working hours except at locations and periods of time approved by the engineer.

Obtain prior approval from the engineer for the location of egress and ingress for construction vehicles to prosecute the work.

The contractor shall conduct a traffic control meeting with the engineer and the City of Madison Traffic engineer prior to the following events. Notification must be given to the engineer 7 business days in advance.

-Initial Traffic Control Set Up

-Each Station Construction

-Closure, Re-Striping, and Opening of Bus Only Lanes

Removals or covering of conflicting pavement marking and signs shall be performed at no cost to the City.

Traffic Control Changes

Submit any traffic control change request to the engineer at least 72 hours prior to an actual traffic control change. A request does not constitute approval.

Local Street Work Restrictions

Existing trees, street light poles, hydrants and other utility poles are to remain in place during construction unless otherwise noted in the plan. Conduct an on-site visit prior to bidding to determine any special measures required for proper clearance between the trees, hydrants and poles and the paving equipment. Any existing trees within the limits of construction to remain shall be protected according to City of Madison standard specification 107.13.

Maintenance of Access

Contractor shall maintain or provide pedestrian access to adjacent properties, businesses, and bus stops throughout the duration of construction.

The contractor shall allow emergency vehicles access throughout the construction zones at all times.

Pedestrian Movements

The contractor shall conduct operations in a manner that will minimize interference to pedestrian and bicycle movements adjacent to the work site and pedestrian access to buildings within the project limits.

The contractor shall always provide and maintain pedestrian walkways within the project limits that provide the following pedestrian movements:

Pedestrian walkways shall be surfaced of existing concrete, asphalt, or temporary pavement and be maintained ADA accessible, and free from mud, sand, and construction debris. Sections of the walkways that are disturbed or removed during construction shall be repaired with temporary pavement or other engineer approved material prior to reopening. Walkway sections shall not be closed overnight. Temporary pedestrian barricades or other engineer approved method shall be installed to guide pedestrian walkways; traffic control barrels shall not be used for pedestrian corridors.

Pedestrian walkways shall have a minimum clear width of 5-feet.

On-Street Parking

The proposed traffic control staging configurations will restrict on-street parking in the areas immediately adjacent to construction operations. The contractor shall coordinate applicable signage requirements with the City of Madison Traffic engineer and the engineer at least three working days prior to the start of construction operations. This shall include, but not be limited to, covering or removing of existing parking restriction signage and posting of temporary parking restrictions required to facilitate construction operations.

Adjacent Streets

The contractor shall always conduct his operations in a manner that will cause a minimum of inconvenience to the free flow of vehicle, bicycle, and pedestrian traffic on all adjacent streets. Temporary lane closures and/or halting of traffic within open roadways for delivery of materials or equipment shall require flaggers. All traffic control items and flaggers for any temporary lane closure for delivery of materials shall be included in the bid item “Traffic Control”, under this contract. The materials and equipment used by the contractor shall remain within the boundaries of the project and traffic control limits as approved by the engineer.

Roadway and sidewalk signing shall be in place as detailed on the plans and special provisions and in conformance with the Manual on Uniform Traffic Control Devices (MUTCD), latest edition. Conflicting signs shall either be covered or removed by the contractor after coordination with the City of Madison Traffic Engineering Division as necessary to avoid confusion. A two-week notice is required to Chad Veinot, 608-267-1960, cveinot@cityofmadison.com to cover or remove traffic signs.

The contractor shall use only City of Madison designated truck routes for material haul roads as detailed in standard spec section 618.

Material Storage

The Brayton Parking Lot located at 1 South Butler Street is available to the contractor to use for material storage. Furnish and install fencing around the storage site. The City of Madison is not liable for theft or damage of materials stored at this site The City of Madison also is exempt from liability to the contractor for damages or delays resulting from improperly securing the storage site.

5-2 Coordination

The contractor shall notify the engineer and the following agencies 48 hours in advance of any changes to traffic operations or closures of streets. Notifications must be given by 4:00 p.m. on Thursday for any such

work to be done on the following Monday. Refer to Article 2 of this document for a comprehensive list of all parties requiring coordination.

-City of Madison Police Department – Cindy Deering, cdeering@cityofmadison.com

-City of Madison Fire Department – Ed Ruckriegel, 608-266-4457, eruckriegel@cityofmadison.com

-City of Madison Traffic Engineering – Chad Veinot, 608-267-1960, cveinot@cityofmadison.com

Tom Mohr, 608-267-8725, tmohr@cityofmadison.com

-City of Madison Streets Division – Charlie Romines, 608-266-4680, cromines@cityofmadison.com

- City of Madison Metro Transit – Mike Cechvala, 608-261-9283, MCechvala@cityofmadison.com

The contractor shall notify the engineer and the following agencies 48 hours in advance of any changes to traffic operations or closures of streets when construction activities are to take place at or immediately adjacent to owner's facilities. Notifications must be given by 4:00 p.m. on Thursday for any such work to be done on the following Monday

-Madison Metropolitan School District - Michael LaCount, mlacount@madison.k12.wi.us

De'Kendrea Stamps, dbstamps@madison.k12.wi.us

Mick Howan, mjhowan@madison.k12.wi.us

Jeff Fedler, jfedler@madison.k12.wi.us

-University of Wisconsin-Madison – Gabe Mendez, 608-890-3268, gabe.mendez@wisc.edu

-Madison College – Fred Brechlin, 608-246-6837 office, 608-576-1352 cell, fbrechlin@madisoncollege.edu

-City of Madison Parks Division – Eric Knepp, 608-266-4711, EKnepp@cityofmadison.com

-Wisconsin and Southern Railroad (WSOR) – Amanda Haggerty, 608-620-2048, ahaggerty@watcocompanies.com

-Capital Square Coordination - Kelly Post, 608-264-9289, KPost@cityofmadison.com

The contractor shall furnish portable changeable message signs at the plan or engineer identified locations 10 calendar days prior, notifying the traveling public of the closure. The contractor shall request message approval from the engineer. A request does not constitute approval.

The contractor is directed to the fact that other separate contracts are, or may be, in force that intersect the construction limits of this project. The contractor shall cooperate with other contractors in the phasing and performance of this work so as not to delay, interrupt, or hinder the progress or completion of the work being performed by other contractors. No additional compensation will be allowed for compliance with the above requirements, nor for any delays or inconveniences resulting from activities of other contractors. Should a conflict arise between contractors with respect to the sequence of construction or maintenance of traffic requirements, said conflicts shall be resolved by, or at the direction of, the engineer. Refer to Article 1-6 of this document for a list of known concurrent projects which may require contractor coordination for traffic control efforts.

5-3 Public Convenience and Safety

Revise standard spec 107.8(4) as follows:

Notify the responsible fire and police department at least 48 hours before any road closures.

Revise standard spec 107.8(6) as follows:

Obtain hours of operation approval from the City of Madison prior to beginning construction.

5-4 Holiday and Other Work Restrictions

The work is expected to start in March 2023 and be complete by August 2024. City of Madison events and other public holidays may increase both vehicular and pedestrian traffic to the project area.

The public holidays include:

2023

From noon Friday, May 26, 2023 to 6:00 AM Tuesday, May 30, 2023 for Memorial Day

From noon Friday, June 16, 2023 to 6:00 AM Tuesday, June 20, 2023 for Juneteenth

From noon Monday, July 3, 2023 to 6:00 AM Wednesday, July 5, 2023 for Independence Day

From noon Friday, September 1, 2023 to 6:00 AM Tuesday, September 5, 2023 for Labor Day

From noon Wednesday, November 22, 2023 to 6:00 AM Monday, November 27, 2023 for Thanksgiving

From noon Friday, December 22, 2023 to 6:00 AM Wednesday, December 27, 2023 for Christmas

2024

From noon Friday, December 29, 2023 to 6:00 AM Tuesday, January 2, 2024 for New Year's Day

From noon Friday, January 12, 2024 to 6:00 AM Tuesday, January 16, 2024 for Martin Luther King Jr. Day

From noon Friday, May 24, 2024 to 6:00 AM Tuesday, May 28, 2024 for Memorial Day

From noon Tuesday, June 18, 2024 to 6:00 AM Thursday, June 20, 2024 for Juneteenth

From noon Wednesday, July 3, 2024 to 6:00 AM Friday, July 5, 2024 for Independence Day

The events include but are not limited to the following. Refer to www.cityofmadison.com/visit-play/annual-events for a list of annual events scheduled. The contractor shall coordinate with the City of Madison on other potential events not listed below which may impact construction timing and traffic control operations, such as University of Wisconsin football games.

2023

May 12th-13th - University of Wisconsin Madison Graduation

Concerts on the Square (Wednesdays thru the Summer; https://wcoconcerts.org/concerts-tickets/concerts-on-the-square)

Dane County Farmer's Market (Saturdays from April thru November; https://www.dcfm.org/)

May thru September (Various Dates) – Madison Night Market (https://visitdowntownmadison.com/madison-night-market)

July 8th – 9th - Art Fair on the Square (https://www.mmoca.org/event/art-fair-on-the-square/)

September 2nd – 3rd - Taste of Madison (https://www.tasteofmadison.com/)

Early September – Ironman Wisconsin (https://www.ironman.com/im-wisconsin)

Late October - Freakfest

Mid November - Madison Marathon (https://madisonmarathon.org/)

2024

Mid March – St. Patrick's Day Parade (https://www.stpatsmadison.org/marching.asp)

Early April – Crazy Legs Classic Run / Walk (https://www.crazylegsclassic.com/)

May 10th-11th - University of Wisconsin Madison Graduation

Concerts on the Square (Wednesdays thru the Summer; https://wcoconcerts.org/concerts-tickets/concerts-on-the-square)

Dane County Farmer's Market (Saturdays from April thru November; https://www.dcfm.org/)

May thru September (Various Dates) – Madison Night Market (https://visitdowntownmadison.com/madison-night-market)

Early July - Art Fair on the Square (https://www.mmoca.org/event/art-fair-on-the-square/)

Traffic control and work hours may need to be modified during this time. Contractor shall comply to changes to the work zones during that time.

One lane in each direction shall always be maintained unless otherwise shown on the plans. Some work on side streets may require one direction of the traffic to be detoured. Such detours shall not be allowed for more than 7 days. All detours will need to be coordinated and approved by the City of Madison before implementation.

It is anticipated that single lane paving operations will be required at various intersections during construction activities which will restrict existing traffic patterns to one lane. These operations shall occur at off peak or weekend hours (Friday 6:00 PM through Monday 7:00 AM) and need to be coordinated and approved with the City of Madison.

Construction operations between Mendota Street / Lien Road and North Stoughton Service Road shall not occur prior to September 1, 2023, unless approved by the engineer.

Do not begin construction operations at the intersection of Mineral Point Road and Whitney Way prior to April 2024, unless approval is obtained by the engineer. Coordinate construction activities at this location with the Widened Sidewalk Project for traffic signal, temporary street lighting, and construction staging. Coordination is incidental to the bid item "Traffic Control."

The construction including excavation through concrete placement and curing of the East Campus Mall station pair, Park Street improvements, and Lake Street improvements shall not occur prior to May 15, 2023 nor from August 15, 2023 to May 15, 2024, unless approval is obtained by the engineer. Provide 2 weeks notice to the engineer if construction adjacent to the campus has begun and will not be complete by May 9, 2024. The notice is to include a safety plan outlining safety procedures to allow temporary suspension of work during move-in or other campus events as identified by the University of Wisconsin. There is no additional compensation and there will be no adjustment to the required final project completion date for temporary suspension of work due to the failure to complete construction adjacent to the University's campus by May 9, 2024.

Begin construction of the BRT stations at Orchard Street after December 19, 2023 to avoid conflict with the University of Wisconsin – Madison School of Computer, Data & Information Sciences Building construction at University Avenue and West Johnson Street between North Orchard Street and North Charter Street.

Should construction operations be scheduled adjacent to or in the vicinity of the Alicia Ashman pedestrian bridge over Campus Drive in the year 2023, the contractor is hereby notified that temporary traffic control patterns may be in place due to concurrent bridge painting. The contractor shall coordinate construction operations at this location accordingly; this coordination is considered incidental to the item "Traffic Control."

Construction improvements in the downtown area shall take place between the months of November and March and work shall not be performed on weekends, unless otherwise approved by the engineer. The contractor shall coordinate all activities and schedule around special events as mentioned earlier in this section. All associated coordination shall be incidental to the bid item "Traffic Control."

The contractor shall not restrict traffic during peak hours on streets with a functional classification of collector or arterial unless otherwise specified in the plans or approved by the engineer. The City of Madison shall assess the contractor $1000 per occurrence for working during peak hours.

For specific peak hour traffic restrictions along East Washington Avenue, refer to the following:

- Westbound (Inbound) Direction:
    - All lanes shall remain open during AM Peak Hours (7:00 AM to 8:30 AM)
    - All lanes shall remain open during PM Peak Hours (4:00 PM to 6:00 PM)
- Eastbound (Outbound) Direction:
    - Single lane closures are allowed during AM Peak Hours (7:00 AM to 8:30 AM)
    - All lanes shall remain open during PM Peak Hours (3:00 PM to 6:00 PM)

Refer to Section 2-1 Prosecution and Progress for additional work restrictions during construction operations.

Failure to Open Road to Traffic

The maximum cumulative total time in which any residential property is completely without driveway access is 20 calendar days. The City of Madison shall assess the contractor $100 per calendar day per driveway when exceeding the maximum allowable closure.

5-5 Measurement

The work to maintain the traffic through improvement locations for the duration of construction shall be measured as each per bid contract. All work related to traffic control will be included in the pay item "Traffic Control" unless listed in Payment section below.

5-6 Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
603.8000	Concrete Barrier Temporary Precast Delivered	LF
603.8125	Concrete Barrier Temporary Precast Installed	LF
614.0905	Crash Cushions Temporary	EACH
643.0300	Traffic Control Drums	DAY
643.0410	Traffic Control Barricades Type II	DAY
643.0420	Traffic Control Barricades Type III	DAY
643.0705	Traffic Control Warning Lights Type A	DAY
643.0715	Traffic Control Warning Lights Type C	DAY
643.0800	Traffic Control Arrow Boards	DAY
643.0900	Traffic Control Signs	DAY
643.1050	Traffic Control Signs PCMS	DAY
643.5000	Traffic Control	EACH
644.1410	Temporary Pedestrian Surface Asphalt	SF
644.1420	Temporary Pedestrian Surface Plywood	SF
644.1430	Temporary Pedestrian Surface Plate	SF
644.1601	Temporary Pedestrian Curb Ramp	DAY
644.1810	Temporary Pedestrian Barricade	LF
649.0105	Temporary Marking Line Paint 4-Inch	LF
649.0505	Temporary Marking Arrow Paint	EACH
649.0605	Temporary Marking Word Paint	EACH
649.0805	Temporary Marking Stop Line Paint 18-Inch	LF

6. Utilities.

This contract does not come under the provision of Administrative Rule Trans 220.

stp-107-0066 (20080501)

There are underground and overhead utility facilities located within the construction limits of the project. There are known utility adjustments required for the construction project as noted below. Coordinate construction activities with a call to Diggers Hotline or a direct call to the utilities that have facilities in the area. Use caution to ensure the integrity of underground facilities and maintain code clearance from overhead facilities at all times. Adjustments in the location of certain described items may be necessary, as directed by the engineer, when it becomes evident that a utility conflict could occur.

Utility work plans are available from the engineer on request.

AT&T Wisconsin – Communications

AT&T Wisconsin has underground facilities within the project limits.

AT&T Wisconsin will relocate manhole from the East Washington Av at Fair Oaks Av/ Wright St platform area, prior to construction.

They will relocate pedestal and overhead cable at existing MG&E Electric pole in proposed Mendota Street Connector pavement, prior to construction.

They will remove a pedestal from the proposed sidewalk at Anderson St Station 23’AN’+85 Lt, prior to construction.

They will adjust frame and cover at: Island Dr 1 MH, Rosa Rd 2 MHs, Regent St south median 1 MH, M. L. King Blvd 1 MH, Fourth St 1 MH, Marquette St 1 MH, Independence Ln 2 MHs. These adjustments will be done during construction. Notify AT&T Wisconsin 14 days before adjustments will be required.

Charter Communications

Charter has underground facilities within the project limits. They will adjust one MH in the sidewalk northwest of East Springs Dr during construction. Notify Charter fourteen days before adjustment will be required.

Lumen – Communications

Lumen has underground facilities within the project limits. They will adjust one HH at East Springs Dr at approximate Station 494+70 Rt during construction. Notify Lumen fourteen days before adjustments will be required.

Lumen has provided facility depths. Contact the engineer for this information.

Madison Gas & Electric – Gas

MG&E-Gas has underground facilities within the project limits.

MG&E will relocate gas facilities for the west segment at the intersections of Mineral Point Road at High Point Road, Mineral Point Road at D'Onofrio Drive/Randolph Drive, Mineral Point Road at Westfield Road, Mineral Point Road at Grand Canyon Drive, Mineral Point Road at Yellowstone Drive, Mineral Point Road at Island Drive, Mineral Point Road at Rosa Road, Mineral Point Road at Whitney Way, Whitney Way at Sheboygan Avenue, Sheboygan Avenue at Eau Claire Avenue, Segoe Road at Sheboygan Avenue. See attached work plan sheets for further details.

MG&E will relocate gas facilities for the east segment at the intersections of Mifflin Street at Wisconsin Avenue if needed, Washington Avenue at Paterson Street if needed, Washington Avenue at Milwaukee Street, Washington Avenue at Mendota Street.

Existing facilities will be discontinued in place.

MG&E will make every effort to relocate prior to construction, but due to the scale of the project, it is not possible. MG&E will coordinate with the City of Madison and their contractor regarding remaining replacement during City's construction and traffic control.

During construction MG&E will adjust valve lids at East Washington Avenue at Baldwin Street and at Johnson Street at N Orchard Street

Madison Gas & Electric – Electricity

MG&E-Electric has overhead and underground facilities within the project limits. They will adjust MHs at E Washington Av at Fourth St and at Mifflin St at Wisconsin Av. These adjustments will be done during construction. Notify MG&E Electric fourteen days before adjustments will be required.

They will relocate the wooden pole at East Washington Av, south of First St, at approximately Station 287+95'WA', 70' Rt. in conflict with the new sidewalk ramp.

They will relocate the pole at East Washington Av, E of Mendota in conflict with proposed bus station.

They will relocate the utility pole at Mendota St connector, approximately Station 501+30'ME', 25' Lt. in conflict with the new roadway. A luminaire will be relocated with pole.

These relocations will be completed prior to construction.

Coordinate with MG&E Electric for relocation of the utility kiosk at State St and Johnson St.

MCI Communications

MCI has underground facilities within the project limits. They will adjust Hand Holes at: Mineral Point Rd at High Point Rd, at Westfield Rd, at Grand Canyon Dr, at Island Dr, at Rosa Rd, Sheboygan Av at Eau Claire Av, University Av at Midvale Blvd, University Av at Orchard St, E Washington Av at Milwaukee St, and E Washington Av at Mendota St WB. These adjustments will be done during construction. Notify MCI fourteen days before adjustments will be required.

MCI has underground facilities along the west curb line of Whitney Way. Use caution when relocating storm sewer inlet at Regent St. No conflict is anticipated with inlet.

TDS Metrocom – Communications

TDS has overhead and underground facilities within the project limits. They will relocate the HH at the Mendota St connector in conflict with the new roadway. Also at his location, they will relocate their overhead line on an MG&E pole. This work will be completed prior to construction.

The following utility companies have facilities within the project area and will have facilities adjusted or relocated by the Contractor as part of this project:

City of Madison – Electric, Signals, Lighting

City of Madison – Sewer

Madison Water Utility

Madison Metropolitan Sewerage District (MMSD)

Metropolitan Unified Fiber Network (MUFN) – Communications

The following utility companies have facilities within the project area with no relocation anticipated:

ATC – Electricity Transmission

AT&T Legacy – Communications

City of Sun Prairie – Sewer

Everstream – Communications

Extenet Systems – Communications

Frontier Communications

Midwest Fiber Networks – Communications

MOX Networks – Communications

ResTech Services – Communications

Rogers Telecom – Communications

Sprint – Communications

SupraNet – Communications

Sun Prairie Utilities – Electricity

Sun Prairie Utilities - Water

TDS Telecom – Communications

US Signal – Communications

Wisconsin Dept of Administration, Div. of Enterprise Tech – Communications

Windstream – Communications

Wisconsin DOT ITS – Communications

Wisconsin Independent Network (WIN) - Communications

6-1 Utility Pothole.

During the design phase select Utility Potholes/Utility Line Openings have been performed. These locations and measurements will be provided upon request.

Any additional potholes performed by the contractor during construction that are directed by the engineer or is needed for the work outlined in the special provisions will be incidental to the contract.

If additional potholes are performed, means and methods outlined in the City of Madison standard specifications shall be followed.

6-2 Adjusting Manhole Covers, Item 611.8110.

This special provision describes adjusting manhole covers conforming to standard spec 611 as modified in this special provision.

Adjust manhole covers located in pavement areas in two separate operations. Initially, remove designated manhole covers along with sufficient pavement to permit installation of temporary cover plate over the

opening. Fill the excavated area with asphaltic pavement mixture, which shall remain in place until contract milling and paving operations permit setting the manhole frames to grade. During the second phase, remove the asphaltic pavement mixture surrounding the manhole plus the temporary cover plate, and set the manhole cover to final grade. The City of Madison will measure and pay for the items of asphaltic pavement mixture, temporary cover plate, milling, and paving separately.

Supplement standard spec 611.3.7 with the following:

Set the manhole frames so that they comply with the surface requirements of standard spec 450.3.2.9. At the completion of the paving, a 6-foot straightedge shall be placed over the centerline of each manhole frame parallel to the direction of traffic. A measurement shall be made at each side of the frame. The two measurements shall be averaged. If this average is greater than 5/8 inches, reset the manhole frame to the correct plane and elevation. If this average is 5/8 inches or less but greater than 3/8 inches, the manhole frame shall be allowed to remain in place but shall be paid for at 50 percent of the contract unit price.

If the manhole frame is higher than the adjacent pavement, the two measurements shall be made at each end of the straightedge. These two measurements shall be averaged. The same criteria for acceptance and payment as above, shall apply.

stp-611-005 (20200629)

6-3 Cover Plates Temporary, Item 611.8120.S.

A Description

This special provision describes providing and removing steel plates to cover and support asphaltic pavement and traffic loading at manholes, inlets and similar structures during milling and paving operations.

B Materials

Provide a 0.25 inch minimum thickness steel plate that extends to the outside edge of the existing masonry.

C (Vacant)

D Measurement

The City of Madison will measure Cover Plates Temporary as each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
611.8120.S	Cover Plates Temporary	EACH

Payment is full compensation for furnishing, installing, and removing the cover plates. The steel plates shall become the property of the contractor when no longer needed in the contract work.

stp-611-006 (20151210)

6-4 Relocate Hydrant, Item SPV.0060.609.

A Description

This special provision describes the removal and relocation of hydrants.

B Materials

Follow City of Madison standard specifications section 704.8.

C Construction

Follow City of Madison standard specifications section 704.8.

D Measurement

The City of Madison will measure Relocate Hydrant as each individual relocation, successfully completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.609	Relocate Hydrant	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

6-5 4’ Dia. Sanitary Sewer Access Structure (SAS), Item SPV.0060.610; 5' Dia. Sanitary Sewer Access Structure (SAS), Item SPV.0060.626.

A Description

This special provision describes installing Sewer Access Structures at the depths and locations shown on the plan.

B Materials

Provide precast concrete Sanitary Sewer Access Structure (Size) meeting the requirements of Standard Detail Drawing 5.7.2, 5.7.15, and Article 507.3 of the City of Madison standard specifications.

Furnishing and installing Sewer Access Structure Frames and Covers, according to Standard Detail Drawing 5.7.16 of the City of Madison standard specifications, will be paid for separately under the Manhole Covers Type J, bid item.

C Construction

Install (Size) Dia. Sanitary Sewer Access Structure (SAS) according to Article 507.3 of the City of Madison standard specifications. Maintain the normal flow of wastewater at all times during installation of the new sanitary sewer access structure and when connecting pipes to the new structure. All bypass pumping, temporary piping, and/or temporary connections, which are required to maintain the normal flow of wastewater throughout construction, is incidental to this bid item.

Construct concrete benches and flow lines as directed by the engineer.

D Measurement

The City of Madison will measure (Size) Dia. Sanitary Sewer Access Structure (SAS) as each individual sanitary sewer access structure, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.610	4’ Dia. Sanitary Sewer Access Structure (SAS)	EACH
SPV.0060.626	5' Dia. Sanitary Sewer Access Structure (SAS)	EACH

Payment is full compensation for installing sanitary sewer access structures, constructing benches and flow lines; for furnishing and installing all bypass or temporary piping and connections.

6-6 Adjust Water Valve, Item SPV.0060.613

A Description

This special provision describes the adjust water valves in accordance with City of Madison standard specification 704.20.

B Materials

Follow City of Madison standard specification 704.20.2.

C Construction

Follow City of Madison standard specification 704.20.3.

D Measurement

The City of Madison will measure Adjust Water Valve as each individual adjustment, successfully completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.613	Adjust Water Valve	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified. Adjustment of new valve boxes is incidental to valve box installations and will not be paid.

6-7 Sanitary Sewer Internal Chimney Seal, Item SPV.0060.617

A Description

Furnish and install an internal chimney seal on all sanitary sewer access structures located within 100 feet of a street low point, in greenways, and where indicated on the plan.

B Materials

Provide an internal chimney seal consisting of either rubber with metal bands or a low-density polyethylene insert conforming to the Standard Detail Drawing 5.7.17–SAS Internal Chimney Seal of the City of Madison standard specifications or other equivalent chimney seal products as approved by the engineer.

C Construction

Install internal chimney seals according to the manufacturer's instructions.

D Measurement

The City of Madison will measure Sanitary Sewer Internal Chimney Seal as each individual sanitary sewer internal chimney seal, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.617	Sanitary Sewer Internal Chimney Seal	EACH

Payment is full compensation for the installation of the sanitary internal chimney seal.

6-8 Sanitary Sewer Tap, Item SPV.0060.618.

A Description

This special provision describes the connection of a new lateral or main to an existing structure and the connection of an existing lateral or main to a new structure.

B Materials

Provide Kor-n-Seal, or approved equal, in the tapped hole, according to Standard Detail Drawing 5.7.31 of the City of Madison standard specifications.

C Construction

C.1 New Pipe to Existing Structure

Use a portable coring drill to produce a pipe opening that is round, clean and free of any pitting of the concrete.

Make a watertight connection of the pipe to the sewer access structure with a Kor-n-Seal or approved equal, according to Standard Detail Drawing 5.7.31 of the City of Madison standard specifications.

C.2 Existing Pipe to New Structure

Provide a flexible connector to connect the existing pipe to any new pipe which is required to make the connection to the structure.

Provide PVC (SDR-26, SDR-35, that matches the existing pipe's diameter, or the next larger diameter, to reconnect the existing sewer main or lateral.

The pouring and construction of concrete benches and flowlines in new sewer access structures for the inlet or outlet pipes is not included in this bid item and is considered incidental to the bid item Sanitary Sewer Access Structure (size).

The downstream pipe connection to a Sewer Access Structure (size) is considered incidental to the Sewer Access Structure (size).

D Measurement

The City of Madison will measure Sanitary Sewer Tap as each individual sanitary sewer tap, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.618	Sanitary Sewer Tap	EACH

Payment is full compensation for providing all connectors and for coring.

6-9 Adjust Manhole Cover Special, Item SPV.0060.619

A Description

This special provision describes adjusting Manhole Covers Sanitary Sewer Access Structure (SAS) castings as called for on the plan set to the final proposed grades. This bid item is required because the casting adjustment is greater than 9 inches of vertical adjustment to set the casting to the final grade or the chimney was determined to be in poor condition. Manhole adjustments less than 9 inches will be paid for separately under Bid Item Adjusting Manhole Covers. Installation of offset cone and casting as called for on the plan will be considered incidental to this bid item. Rotation of an existing cone sections will be considered incidental to this bid item.

B Materials

Provide precast concrete barrel sections and manhole adjustment rings meeting the requirements of Article 507.3 as well as SDD 5.7.2 and 5.7.15 of the City of Madison standard specifications.

C Construction

Complete adjust SAS Special according to Article 507.3 of the City of Madison standard specifications. This bid item will require adjustment rings to be removed and concrete barrel sections to be installed. The maximum allowed adjustment on the Sewer Access Structure will not exceed 9 inches and the final configuration of the structure will be in accordance of SDD 5.7.2 and 5.7.15 of the City of Madison standard specifications. If the sewer access structure being adjusted is a poured in place structure (4 x 4, 5 x 5, or 6 x 6), install a 4-foot diameter barrel section on the poured in place manhole rooftop and place a concrete collar where the barrel section connects to the manhole rooftop. Center the barrel section over the casting opening. If the existing casting is offset, sawcut the manhole rooftop to create an opening centering the barrel section on the manhole rooftop.

D Measurement

The City of Madison will measure Adjust Sanitary Sewer Access Structure Special as each individual adjust sanitary sewer access structure, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.619	Adjust Manhole Cover Special	EACH

Payment is full compensation for adjusting sanitary sewer access structure, sawcutting the roof, and installing mastic and concrete collars.

6-10 Manhole Cover Type J Special, Item SPV.0060.620

A Description

This special provision describes installing City of Madison manhole castings in accordance with the pertinent requirements of WisDOT standard spec 611 and the construction details shown in the plans.

B Materials

Provide castings according to standard spec 611 and Article 507 of the City of Madison standard specifications and as shown on the plans. Provide lids with logo per City of Madison standard detail drawing 5.7.16.

C Construction

Perform work in accordance with standard spec 611.

D Measurement

The City of Madison will measure Manhole Cover Type J Special by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.620	Manhole Cover Type J Special	EACH

Payment shall be in accordance with section 611.5.4 of the standard specifications, including the removal of the cover.

6-11 Furnish & Install 1-Inch Water Service, Item SPV.0060.622

A Description

This special provision describes the installation of water service laterals in accordance with City of Madison standard specification 704.9.1 including connection to light bases and irrigation systems as necessary.

B Materials

Follow City of Madison standard specification 704.9.2.

C Construction

Follow City of Madison standard specification 704.9.3.

D Measurement

The City of Madison will measure Furnish & Install Water Service Laterals as each individual installation, successfully completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.622	Furnish & Install 1-Inch Water Service	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

6-12 Remove Irrigation System, Item SPV.0060.623

A Description

This special provision describes removal of irrigation materials and apparatuses and the cap of the irrigation service at the location indicated in the plan. Materials shall conform to City of Madison standard specification Part VII.

B Materials

Follow City of Madison standard specification 702.

C Construction

Follow City of Madison standard specification 703.

D Measurement

The City of Madison will measure Remove Irrigation System as each individual removal acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.623	Remove Irrigation System	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

6-13 Remove and Replace Irrigation System, Item SPV.0060.627

A Description

This special provision describes removal and replacement of irrigation materials and apparatuses at the location indicated in the plan and the adjustment, reconnection, and splicing of irrigation effected by construction. Materials shall conform to City of Madison standard specification Part VII. Confirm details for replacement with the engineer.

B Materials

Follow City of Madison standard specification 702.

C Construction

Follow City of Madison standard specification 703.

D Measurement

The City of Madison will measure Remove and Replace Irrigation System as each individual system acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.627	Remove and Replace Irrigation System	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

6-14 Remove Sanitary Sewer Access Structure, Item SPV.0060.629.

A Description

This special provision describes removing sanitary sewer access structures as shown on the plans and salvaging and disposing of the resulting materials and backfilling the trenches with select fill.

B Materials

Provide select fill meeting the requirements of Article 202.2 of the City of Madison standard specifications; furnishing and placing select fill in the void created by the structure removal is included with this bid item.

C Construction

Remove sanitary sewer access structures according to Article 203.2(a) of the City of Madison standard specifications. Plugging of sewer mains and laterals that are connected to a removed Sanitary Sewer Access Structure with a concrete plug are incidental to this item. Payment for Concrete Slurrying of an entire sewer main will be paid for separately under Abandon Sanitary Sewer–Slurry.

D Measurement

The City of Madison will measure Remove Sanitary Sewer Access Structure as each individual remove sanitary sewer structure, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.629	Remove Sanitary Sewer Access Structure	EACH

Payment is full compensation for furnishing all materials, including fill material; for disposal of surplus materials; excavation and compaction of select fill material; restoring the site.

6-15 Wastewater Control, Item SPV.0060.630.

A Description

This special provision describes controlling or diverting sanitary sewer flows during reconstruction of the sanitary sewer.

B (Vacant)

C Construction

Provide a pump with a capacity of 100 gallons per minute (City of Madison) all associated equipment required to maintain a functioning sanitary sewer system during construction. It is not acceptable, at any time, to disrupt normal flow of wastewater in sanitary sewer service laterals without prior approval from the City of Madison. This condition also holds at the time of connection of an existing lateral to the new sewer main.

If the contractor elects to use bypass pumping as a means of wastewater control, the methods, equipment, type of hose, etc. are subject to approval by the engineer. Ramp any hoses crossing streets, driveways, parking areas, etc., to prevent damage to hoses. Contain spillage of wastewater to be within the utility trench and dispose of spillage into existing sewer downstream to previously

installed sewer piping. Spillage of wastewater to adjacent streets, lawns, etc. will not be tolerated. Should spillage occur, cease all construction operations immediately and begin cleanup operations. Clean site thoroughly prior to the resumption of any construction operations.

D Measurement

The City of Madison will measure Wastewater Control once for the contract acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.630	Wastewater Control	EACH

Payment is full compensation for controlling or diverting all sanitary sewer flows during construction of sanitary sewer.

6-16 Furnish and Install Insulation, Item SPV.0060.631.

A Description

This special provision describes furnishing and installing insulation as follows:

1. Install new copper service laterals and related accessories.
2. Tapping the water main and installing or repairing polyethylene water main encasement.
3. Installing the associated service lateral fittings and curb box.
4. Adjusting the new curb box relative to finished grade.
5. Removing any existing curb stops/curb boxes inside the excavated service ditch.
6. Placing imported select fill in trench excavations.
7. Disposal of excess excavated material.
8. Restoration of disturbed terrace or turf areas.

B Materials

Follow City of Madison standard specifications section 704.9.

C Construction

Follow City of Madison standard specifications section 704.9.

D Measurement

The City of Madison will measure Furnish and Install Insulation as each individual installation, successfully completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.631	Furnish and Install Insulation	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

6-17 Furnish and Install 2-Inch Service Lateral, Item SPV.0060.632.

A Description

This special provision describes the installation of rigid board to insulate water mains and/or water service laterals. Styrofoam insulation is required when:

1. The top of water main or service lateral has 5-feet of cover or less.
2. The water main or service lateral crosses below storm sewer.
3. When otherwise specified on the drawings or as directed by the engineer.

B Materials

Follow City of Madison standard specifications section 704.17.2.

C Construction

Follow City of Madison standard specifications section 704.17.3.

D Measurement

The City of Madison will measure Furnish and Install 2-Inch Service Lateral as each individual installation, successfully completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.632	Furnish and Install 2-Inch Service Lateral	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

6-18 Adjust MMSD Special, Item SPV.0060.633.

A Description

This special provision describes adjusting Sanitary Sewer Access Structure (Rim) castings as shown on the plans to the final proposed grades or directed by the City of Madison according to 507.3 of the City of Madison Standard Specifications - Latest Edition. This bid item is required for vertical casting adjustments greater than 9 inches or to replace a chimney seal in poor condition, as indicated by the City of Madison. MMSD will supply castings and covers at no cost.

B (Vacant)

C Construction

Please call Ray Schneider (MMSD) at 608-347-3628 five days prior to the adjustment.

Remove existing adjustment rings and concrete barrel section(s) as necessary to install new adjustment rings and/or barrel sections needed to reach the final proposed grade as shown on the plans or as directed by the City of Madison.

Rotate the existing cone section as shown on the plans.

Install an offset cone section and casting as shown on the plans. Adjustment ring heights exceeding 9 inches will not be allowed.

D Measurement

The City of Madison will measure Adjust MMSD Special as each individual adjustment, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.633	Adjust MMSD Special	EACH

Payment is full compensation for excavating, exposing, backfilling, disposing of surplus material, and restoring the site; for necessary structure reconstruction or adjustment; offset cone and offset cone rotation and/or installation; and for furnishing and installing all materials, and select fill.

Manhole adjustments less than 9 inches will be paid for separately under bid item Adjusting Manhole Covers.

6-19 PVC Pipe 8-Inch, Item SPV.0090.602; PVC Pipe 4-Inch, Item SPV.0090.607; PVC Pipe 6-Inch, Item SPV.0090.608; PVC Pipe 10-Inch, Item SPV.0090.609; PVC Pipe 12-Inch, Item SPV.0090.612

A Description

This special provision describes furnishing and installing Poly Vinyl Chloride (PVC) storm sewer pipe.

B Materials

Provide solid-wall PVC storm sewer pipe and fittings meeting the requirements of ASTM D 3034.

Provide pipe and fittings having a standard dimension ratio of 26 or 35.

Assemble solvent cement joints using solvent cement obtained from the pipe manufacturer, which conforms to the requirements of ASTM D2564.

The assembled joint must pass the performance tests as required in ASTM D3212.

Provide ASTM D3034 SDR-26 pipe for storm sewer mains deeper than 12 feet.

C Construction

Install PVC storm sewer pipe in accordance to the applicable provision of standard spec 520, at the alignment and grades shown on the plans. Install pipe fittings in accordance to the manufacturer's recommendation.

D Measurement

The City of Madison will measure Storm Sewer Pipe PVC (Size) by the lineal foot, acceptable completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.602	PVC Pipe 8-Inch	LF
SPV.0090.607	PVC Pipe 4-Inch	LF
SPV.0090.608	PVC Pipe 6-Inch	LF
SPV.0090.609	PVC Pipe 10-Inch	LF
SPV.0090.612	PVC Pipe 12-Inch	LF

Payment is full compensation for providing all materials, including fittings; for all excavating except rock excavation; for forming the foundation; providing and removing sheeting and shoring; for laying pipe and sealing joints, and making connections to new or existing fixtures; and for backfilling, for providing granular backfill material, including bedding material.

6-20 4-Inch Sanitary Sewer Lateral, Item SPV.0090.603; 6-inch Sanitary Sewer Lateral, SPV.0090.611

A Description

This special provision describes excavating required trenches, connecting the lateral to the mainline pipe, placing bedding material, connecting the new lateral to the existing lateral, all required fittings, couplings, and bends, backfilling and compacting the trenches and restoring the work site as provided by the plans, specifications and contract. This work also consists of locating, identifying, and abandoning "inactive" laterals.

B Materials

Furnish sanitary sewer pipe and fittings that are solid-wall Poly Vinyl Chloride (PVC) and that conform to the requirements of the Specification for PVC Sewer Pipe and Fittings, ASTM D 3034.

Provide sanitary sewer pipe and fittings having a standard dimension ratio of 26 or 35.

Furnish elastomeric or solvent cement joints made as recommended by the manufacturer.

Sewer laterals deeper than 12 feet will be required to be ASTM D3034 SDR-26.

Install AWWA C900 Class 150, DR-18 Pipe type will be installed for laterals where the sewer main being installed is Sanitary Sewer Pressure Pipe (C900).

Install compression coupling connections to the existing sewer laterals in conformance to Standard Detail Drawing 5.3.3, Coupling detail, from the City of Madison standard specifications.

C Construction

Furnish sanitary sewer pipe and fittings that are solid-wall Poly Vinyl Chloride (PVC) and that conform to the requirements of the Specification for PVC Sewer Pipe and Fittings, ASTM D 3034.

Provide sanitary sewer pipe and fittings having a standard dimension ratio of 26 or 35.

Furnish elastomeric or solvent cement joints made as recommended by the manufacturer.

Sewer laterals deeper than 12 feet will be required to be ASTM D3034 SDR-26.

Install AWWA C900 Class 150, DR-18 Pipe type will be installed for laterals where the sewer main being installed is Sanitary Sewer Pressure Pipe (C900).

Install compression coupling connections to the existing sewer laterals in conformance to Standard Detail Drawing 5.3.3, Coupling detail, from the City of Madison standard specifications.

D Measurement

The City of Madison will measure (Size) Sanitary Sewer Lateral, by the linear foot, acceptably completed. The quantity to be paid will be measured from the connection of the mainline sewer pipe to the connection of the existing sanitary lateral along the centerline of the pipe.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.603	4-Inch Sanitary Sewer Lateral	LF
SPV.0090.611	6-Inch Sanitary Sewer Lateral	LF

Payment is full compensation for determining whether laterals are “active”, “inactive”, or abandoned, and the exact location and size of “active” lateral reconnections.

Connection of lateral to the proposed sewer main and the first 5 feet of lateral pipe associated with the connection is paid under bid item Sanitary Lateral Reconnect.

Select fill for sanitary sewer lateral is paid under bid item Select Fill For Sanitary Sewer. The quantity for this item may be increased or decreased beyond the limits set forth in section 104 of the City of Madison standard specifications.

6-21 8-Inch Sanitary Sewer Pipe, Item SPV.0090.604.

A Description

This special provision describes installing a Poly Vinyl Chloride (PVC) sanitary sewer pipe at the alignment and grades shown on the plan. All sections of the sewer mainline are required to pass a low pressure air test, mandrel test, and a visual inspection via televising as specified in section 501.3(b) of the City of Madison standard specifications. Testing of the gravity main is included in this item.

Maintain the normal flow of wastewater at all times during replacement of the existing sanitary sewer main with the new sanitary sewer main. Payment for furnishing all bypass pumping, temporary piping, and/or temporary connections, which are required to maintain the normal flow of wastewater throughout the sewer construction, is under the bid item for Wastewater Control.

B Materials

Provide solid-wall PVC sanitary sewer pipe and fittings meeting the requirements for PVC Sewer Pipe and Fittings, ASTM D 3034.

Provide pipe and fittings having a standard dimension ratio of 26 or 35 as called out on the plan set. Furnish elastomeric or solvent cement joints as recommended by the manufacturer.

The assembled joint will be required to pass the performance tests as required in ASTM D3212. Sewer mains deeper than 12 feet will be required to meet the standards or ASTM D3034 SDR-26.

C Construction

Install the sanitary sewer pipe according to all applicable provisions of the City of Madison standard specifications.

Remove all abandoned or existing material located within 3 feet of the new sanitary sewer alignment. Removal of material (including existing sanitary sewer/water main/etc.) is incidental to this bid item.

Use manufactured wye fittings to install new laterals to the new main as called for on the plans; provide and place according to standard spec 503 for City of Madison standard specifications. Do not install saddle type wyes without prior approval from the City of Madison.

Complete testing and televising of new sewer lines according to Article 501 of the City of Madison standard specifications.

D Measurement

The City of Madison will measure 8-Inch Sanitary Sewer Pipe PVC, in length by the linear foot, acceptably completed.

8-Inch Sanitary Sewer Pipe PVC will be measured through sanitary sewer structures, from the center of sanitary sewer casting to center of sanitary sewer casting. 8-inch Sanitary Sewer Pipe PVC not terminating at a sanitary sewer structure will be measured to the end of pipe. Deductions from the measure length will not be made for wye installations.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.604	8-Inch Sanitary Sewer Pipe	LF

Payment is full compensation for excavation of the trench, except tunneling and jacking; installation and removal of sheeting and bracing; removal of water from the trench; disposal of surplus material from the trench; backfilling the trench and compaction of the backfill material; embankment over the sewer using surplus material from the excavation of the trench; bedding the pipe; laying the pipe and installing the fittings and accessories; jointing and sealing of joints in pipe, fittings and accessories; encasement, where specified; connections to existing structures; cleaning out the sewer; and restoring the site.

6-22 Select Fill for Sanitary Sewer, Item SPV.0090.610

A Description

This special provision describes furnishing and placing select fill over the sanitary sewer main and laterals along the entire length of the pipe.

B Materials

Provide select fill meeting the requirements of Article 202.2(b) of the City of Madison standard specifications for select fill for sanitary sewer mains and laterals.

C Construction

Install select fill for sanitary sewer according to all applicable provisions of Article 502.1(e) of the City of Madison standard specifications.

D Measurement

The City of Madison will measure Select Fill for Sanitary Sewer in length by the linear foot, acceptably completed. Measurement will be completed along the centerline of the installed sanitary sewer pipe and includes the length through Sewer Access Structures.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.610	Select Fill for Sanitary Sewer	LF

Payment is full compensation for furnishing and placing select fill for sanitary sewer.

6-23 Construct Outside Drop 8-Inch, Item SPV.0200.601

A Description

This special provision describes constructing inside drop structures on sanitary sewer access structures where shown in the drawings, or as directed by the City of Madison. Outside Drops are required if the elevation difference between the flow line of the incoming pipe and the springline of the outgoing pipe is greater than two feet.

B Materials

Provide all materials associated with this item according to Standard Detail Drawing 5.7.2 and section 507.3(d)1 of the City of Madison standard specifications.

C Construction

Construct Outside Drop according to section 507.3(d)1 of the City of Madison standard specifications.

Maintain the normal flow of wastewater at all times during installation of the sanitary sewer access structure, construction of the outside drop structure, and when connecting new and existing pipes to the structure.

Complete any necessary temporary wastewater control according to the City of Madison standard specifications, and as described under bid item Wastewater Control item.

D Measurement

The City of Madison will measure Construct Outside Drop 8-Inch by the vertical foot measured from the invert of the entree tee to the springline of the outgoing sewer according to City of Madison Standard Detail Drawing 5.7.2. If the manhole has a bench above the spring line of the outgoing sewer, the inside drop shall be measured from the invert of the tee to the top of the manhole structure bench. Sanitary tap connections for the inside drop shall be considered incidental to this bid item.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0200.601	Construct Outside Drop 8-Inch	VF

Payment includes all equipment, labor and materials necessary to complete this item as specified.

7. Clear – Demolition – Removal.

7-1 Detectable Warning Fields.

Add the following to standard spec 204.5.1:

Payment for Removing Sidewalk includes the removal of existing detectable warning fields.

7-2 Removing Retaining Wall and Railing, Item 204.9090.S.01.

A Description

This special provision describes removing retaining wall and associated railing conforming to standard spec 204.

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Removing Retaining Wall and Railing in linear feet, acceptably completed.

E Payment

Add the following to WisDOT standard spec 204.5:

ITEM NUMBER	DESCRIPTION	UNIT
204.9090.S.01	Removing Retaining Wall and Railing	LF

stp-204-025 (20150630)

7-3 Removing Pedestrian Handrail, Item 204.9090.S.02.

A Description

This special provision describes removing Pedestrian Handrail conforming to standard spec 204.

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Removing Pedestrian Handrail in linear feet acceptably completed.

E Payment

Add the following to WisDOT standard spec 204.5:

ITEM NUMBER	DESCRIPTION	UNIT
204.9090.S.02	Removing Pedestrian Handrail	LF

stp-204-025 (20150630)

7-4 Remove and Salvage Fence, Item 204.9090.S.03.

A Description

This special provision describes removing median fence conforming to standard spec 204.

B (Vacant)

C Construction

Perform a field review of existing fence with the engineer to identify condition of the existing fence before removal. The engineer will identify all items to be removed and salvaged or disposed.

Remove all fence, posts, and flanges from their concrete footings and disassemble out of traffic. Removal of concrete bases will be paid for separately.

After removal of fence, store salvaged material at a mutually agreed location with the engineer.

D Measurement

The City of Madison will measure Remove and Salvage Fence in linear feet, acceptably completed.

E Payment

Add the following to WisDOT standard spec 204.5:

ITEM NUMBER	DESCRIPTION	UNIT
204.9090.S.03	Remove and Salvage Fence	LF

stp-204-025 (20150630)

7-5 Remove and Salvage Metro Local Route Shelter, SPV.0060.432.

A Description

This special provision describes the removal and salvage of existing Metro Local Route shelters.

B (Vacant)

C Construction

Remove only after coordination with Metro. Remove electrical cutoff/disconnection to shelter. Salvage and protect all shelter components.

Deliver shelter to 3829 Hanson Road, Madison WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for delivering the salvaged shelter, minimum of three working days prior to delivery.

D Measurement

The City of Madison will measure Remove and Salvage Metro Local Route Shelter by each unit removed, salvaged and delivered to Hanson Road.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.432	Remove and Salvage Metro Local Route Shelter	EACH

Payment is for removal, salvaging, protecting and delivery of Metro shelters.

8. Earthwork.

8-1 Excavation Common.

Replace standard spec 205.4.1(1) with the following:

City of Madison will measure all excavation by the cubic yard, acceptably completed, as computed using alternate methods involving anticipated depth measurements based on typical proposed section and assumed existing pavement thickness multiplied by area of pavement removal, and as computed by alternate methods involving comparison of surfaces between proposed and existing at the Junction Road terminal.

Excavation for utility trenches and disposals of surpluses and unsuitable material is incidental to the other items of this project and will not be paid for separately.

8-2 Campus Drive Excavation for Barrier, Site Preservation & Restoration, SPV.0105.001.

A Description

This special provision describes the earthwork, preventative measures, and the restoration of impacted items, including landscaping and hardscape, required to construct the concrete barrier and base course along eastbound Campus Drive.

B Materials

Backfill materials shall comply with standard spec 206.2.

C Construction

C.1 General

Submit a workplan for the excavation of the site at least two months prior to construction on Campus Drive. Include method of excavation, such as excavation with or without sheeting, anticipated impacts based on construction method, anticipated preservation needs during construction, and anticipated restoration. A meeting with the property owner will be set up by the engineer once an accepted workplan is received and reviewed by the engineer. Attend the meeting and explain the workplan and make adjustments to the workplan as needed based on property owner's concerns.

Contractor shall comply with standard spec 107.8 and 107.11.

C.2 Excavation

Excavate per standard spec 206.3.

C.3 Preservation

Construct in a manner which protects the existing building and utilities. Limit parking lot, landscaping, and hardscape impacts during construction.

C.4 Restoration

Furnish and install materials necessary to restore the site.

D Measurement

The City of Madison will measure Campus Drive Excavation for Barrier, Site Preservation & Restoration, completed in accordance to the contract and accepted.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.001	Campus Drive Excavation for Barrier, Site Preservation & Restoration	LS

Payment is full compensation for submitting a workplan showing means, methods, and details of construction, coordination with property owner, removal and reinstallations of signs (if impacted by excavation) replanting and care for grasses and bushes (if impacted by excavation), parking lot removals and restoration (if impacted by excavation), concrete removals and restoration near the east end of the building (if impacted by excavation), traffic control items for the parking lot adjacent to the excavation, temporary sheeting (if used), and furnishing all materials required to excavate for the concrete barrier and furnishing and installing all materials required for preservation of and restoration of the site. The City of Madison will pay separately for excavation required for the travel lane, curb and gutter, clearing and grubbing.

9. Bases, Subbases, and Pavements.

9-1 General Requirements for Concrete Pavements.

Concrete to be removed and replaced shall be sawcut at the nearest existing joint.

Replace standard spec 415.3.7.1(2) with the following:

Plan and locate points necessary to establish the horizontal position of transverse and longitudinal joints to prevent uncontrolled cracking and to specify limits of colored concrete versus non-colored concrete . Submit a joint layout design to the engineer at least 7 calendar days before paving each intersection. Do not lay out joints until the engineer has reviewed the joint layout design. Mark the location of concrete joints in the field. Follow the concrete pavement jointing plan details making adjustments as required to fit field conditions. For unique project circumstances not covered in the plan details, review the joint layout plan with the engineer.

9-2 General Requirements for Pavements.

All bituminous and Portland cement concrete proportioning plants and crushers must meet the requirements for the rules of Part 55 Air Pollution Control, of Act 451, Natural Resource and Environmental Protection.

9-3 Stamping Colored Concrete.

This special provision describes stamping and coloring concrete WisDOT Red for work constructed under other contract bid items. Conform to standard spec 405 as modified in this special provision.

Replace the entire contents of standard spec 405.2.2 with the following:

(1) Stamping pattern shall match existing. See 405.2.1 for coloring materials.

Replace the entire contents of standard spec 405.3.2 with the following:

(1) Color concrete full-depth conforming to standard spec 405.3.1.

(2) Coordinate with the Engineer and verify stamping pattern orientation prior to starting the stamping work. While concrete is still in the plastic state, apply imprinting tools to the surface and press into the concrete to create the desired impression. Check all depths of imprints by tool-to-tool surface leveling. Perform tooling as stamping tools are removed after imprinting. Eliminate all squeeze joints between stamping tools, if any, with hand tools prior to concrete setting. Finish all surfaces uniformly.

9-4 Backfill Coarse Aggregate Size No. 1, Item 209.0300.S.

A Description

This special provision describes furnishing and placing coarse aggregate backfill size no. 1 as the plans show.

B Materials

Provide clean coarse aggregate conforming to the requirements as specified under standard spec 209.2, except gradation shall conform to standard spec 501.2.7.4.

C Construction

Construct the coarse aggregates according to standard spec 209.3.

D Measurement

The City of Madison will measure Backfill Coarse Aggregate Size No. 1 in volume by the cubic yard in the vehicle.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
209.0300.S	Backfill Coarse Aggregate Size No. 1	CY

Payment is full compensation for furnishing and installing the aggregate.

stp-209-030 (20210708)

10. General/Roadway.

10-1 Landmark Reference Monuments.

Any reference monument impacted during construction shall be replaced or adjusted in accordance to standard spec 621. All work with replacing or adjusting existing monuments impacted during construction are incidental to the project.

10-2 Construction Staking.

Contractor shall verify existing match points prior to continuing with survey. In the event of existing match points are not the same as anticipated values, contractor shall notify the engineer prior to continuing survey. Work through discrepancies prior to restarting the survey. This is incidental to the contract.

10-3 Concrete Gutter 24-Inch, Item 601.0150.

Add the following to standard spec 601.3.9 (1):

Construct Concrete Gutter 24-Inch integrally with the pavement.

10-4 Construction Staking Sidewalk, Item SPV.0060.001.

A Description

This special provision describes sidewalk staking which shall comply with subsection 650.3.15 of the standard specifications.

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Construction Staking Sidewalk by each individual project.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.001	Construction Staking Sidewalk	EACH

The City of Madison will not make final payment for any staking item until the contractor submits survey notes and computations used to establish the required lines and grades to the engineer within 21 days of completing this work. The City of Madison will deduct from payments due the contractor for the additional costs specified in standard spec 105.6.

Payment for the Construction Staking bid items is full compensation for locating and setting construction stakes; for adjusting stakes to ensure compatibility, in accordance with the drawings and as set forth in these specifications.

10-5 Concrete Curb & Gutter Bike Ramp Special, Item SPV.0060.002.

A Description

This special provision describes constructing concrete curb and gutter bike ramp as shown in the plans, as shown in the construction detail drawing, and in accordance with standard spec 601.

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each Concrete Curb & Gutter Bike Ramp Special acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.002	Concrete Curb & Gutter Bike Ramp Special	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-6 Adjusting Kiosk, Item SPV.0060.004.

A Description

This special provision describes the adjustment of the existing kiosk on State Street as identified in the plans.

B (Vacant)

C (Vacant)

Coordinate with City of Madison staff to vertically adjust the existing kiosk structure to provide access to the existing utility panel. As directed by City of Madison staff and the engineer, use the existing anchor bolt system to vertically adjust the cabinet height to allow for proper opening of the cabinet door.

D Measurement

The City of Madison will measure each Adjusting Kiosk acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.004	Adjusting Kiosk	EACH

Payment is full compensation for all materials, labor and incidentals for adjusting the kiosk, in accordance with the drawings and as set forth in these specifications.

10-7 Coring Existing Sidewalk for New Railing, Item SPV.0060.005.

A Description

This special provision describes the coring existing concrete sidewalk to allow for installation of railing posts.

B (Vacant)

C Construction

Core the existing concrete sidewalk to the size shown in the plans or as directed by the engineer.

D Measurement

The City of Madison will measure each Coring Existing Sidewalk for New Railing acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.005	Coring Existing Sidewalk for New Railing	EACH

Payment is full compensation for all materials, labor and incidentals for coring the existing sidewalk, in accordance with the drawings and as set forth in these specifications.

10-8 Sloped Concrete Barrier End Treatment, Item SPV.0060.006.

A Description

This special provision describes the construction of the eastbound Campus Drive concrete end treatment.

B (Vacant)

C Construction

Construct barrier end treatment as shown in the plans, as shown in the construction detail drawing, and in accordance with standard spec 603.

Submit shop drawings to the engineer and obtain approval before construction of end treatment.

D Measurement

The City of Madison will measure each Sloped Concrete Barrier End Treatment acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.006	Sloped Concrete Barrier End Treatment	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the barrier end treatment, in accordance with the drawings and as set forth in these specifications.

10-9 Concrete Curb & Gutter 30-Inch Type A Special, Item SPV.0090.001; Concrete Curb & Gutter 18-Inch Type A Special, Item SPV.0090.002; Concrete Curb & Gutter 24-Inch Type H Special, SPV.0090.003.

A Description

This special provision describes the construction of curb and gutter.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans, as shown on City of Madison standard detail drawing, and in accordance with WisDOT standard spec 601.

D Measurement

The City of Madison will measure Concrete Curb & Gutter (Size) (Type) Special by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.001	Concrete Curb & Gutter 30-Inch Type A Special	LF
SPV.0090.002	Concrete Curb & Gutter 18-Inch Type A Special	LF
SPV.0090.003	Concrete Curb & Gutter 24-Inch Type H Special	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-10 Concrete Curb & Gutter Integral 24-Inch Special, Item SPV.0090.004.

A Description

This special provision describes the construction of a City of Madison standard curb and gutter, paved integral to the lane.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans, as shown on City of Madison standard detail drawing for Type H curb, and paved integrally with the adjacent concrete pavement in accordance with WisDOT standard spec 601.

D Measurement

The City of Madison will measure Concrete Curb & Gutter Integral 24-Inch Special by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.004	Concrete Curb & Gutter Integral 24-Inch Special	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-11 Concrete Curb & Gutter 4-Inch Integral 24-Inch Special, Item SPV.0090.005.

A Description

This special provision describes the construction of an integral curb and gutter.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans, as shown in the construction detail drawing, and paved integrally with the adjacent lane in accordance with standard spec 601.

D Measurement

The City of Madison will measure Concrete Curb & Gutter 4-Inch Integral 24-Inch Special by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.005	Concrete Curb & Gutter 4-Inch Integral 24-Inch Special	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-12 Concrete Curb Platform Extension 6-Inch, SPV.0090.006; Concrete Curb Platform Extension 24-Inch, SPV.0090.007.

A Description

This special provision describes the construction of the nominal 6-inch and 24-inch wide concrete curb extended from the platform as detailed in the plans.

B Materials

B.1 General

Furnish materials in compliance with standard spec 601.2 and as shown in the plans.

Provide deformed bars conforming to ASTM A615, Grade 60, with epoxy coating in accordance with ASTM A775. Shop bend reinforcement before coating. Maintain thickness of the coating at 7 mil +/- 2 mil. Coat cut ends.

Chairs, bolsters, bar supports and spacers shall be sized and shaped for strength and support of reinforcement during concrete placement. Use wire reinforcement supports coated with dielectric material for support of epoxy-coated reinforcement. Provide 3-inch by 3-inch plain precast concrete blocks or concrete brick for support of bottom reinforcement.

C Construction

Prepare foundation, install forms, set rebar, place concrete, finish concrete, and cure concrete in compliance with standard spec 601.3 and as shown in the plans.

Place, support and secure reinforcement against displacement.

Provide additional reinforcement bars to support top reinforcement.

D Measurement

The City of Madison will measure Concrete Curb Platform Extension 6-Inch and Concrete Curb Platform Extension 24-Inch by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.006	Concrete Curb Platform Extension 6-Inch	LF
SPV.0090.007	Concrete Curb Platform Extension 24-Inch	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-13 Cold Weather Protection of Concrete Curb & Gutter (Polyethylene), Item SPV.0090.008; Cold Weather Protection of Concrete Sidewalk & Drive (Polyethylene), Item SPV.0165.003; Cold Weather Protection of Concrete Pavement (Polyethylene), Item SPV.180.001.

A Description

This special provision describes placing coverings over poured concrete under cold weather conditions.

B Materials

Furnish materials that meet the requirements specified in City of Madison standard spec 301.8 and WisDOT standard spec 415.3.13.2.

C Construction

Place protective covering according to City of Madison standard spec 301.8, the plans, standard detail drawings, and as hereinafter provided.

D Measurement

The City of Madison will measure Concrete Pavement Protection of Concrete Curb & Gutter (Polyethylene) by the linear feet, acceptably completed.

The City of Madison will measure Concrete Pavement Protection of Concrete Sidewalk & Drive (Polyethylene) by the square foot, acceptably completed.

The City of Madison will measure Concrete Pavement Protection of Concrete Pavement (Polyethylene) by the square yard, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.008	Cold Weather Protection of Concrete Curb & Gutter (Polyethylene)	LF
SPV.0165.003	Cold Weather Protection of Concrete Sidewalk & Drive (Polyethylene)	SF
SPV.0180.001	Cold Weather Protection of Concrete Pavement (Polyethylene)	SY

Payment is full compensation for supplying the polyethylene and material sufficient to weigh down the insulating materials to withstand wind; remove, replace and dispose of all covering materials as required during normal concreting operations. Heating of water, aggregates, or both, if deemed necessary by the contractor to maintain placement temperature, is incidental to these items.

Payment for Cold Weather Protection of Concrete Pavement (Polyethylene) includes cold weather protection associated with the reinforced concrete platforms, concrete sloped walkway, crescent wall and roadway pavement.

10-14 Campus Railing, SPV.0090.013.

A Description

This special provision describes providing railing at the locations indicated on the plans and in accordance with standard spec 513.

B Materials

2-inch x 4-inch powder coated rectangular carbon steel tube post and rail.

Rectangular steel anchor plate.

1/8-inch plastic shim.

½-inch diameter stainless steel stud anchors and hardware.

Tube post insert with tamper proof pins.

Frost-depth CIP concrete footing or concrete pavement slab.

Color to match existing.

C Construction

Construct railing as described below and in accordance with standard spec 513.

Construct the railing 3.5'-feet in height with a minimum length of 98-inches and maximum length of 120-inches. Contractor to field verify required height and length prior to fabricating to match existing.

Mount steel plate to existing sidewalk through 9/16-inch drilled diameter holes with stainless steel stud anchors with 3-inch embedment. Anchors shall be 2-inch minimum clear of exposed concrete surfaces for footing conditions. Provide plastic shim between steel plate and footing held ¼-inch from outside edge of plate.

Weld tube post insert to steel plate. Insert tamper proof pins through post and post sleeve, typical 2 per post.

Submit shop drawings to the engineer and obtain approval before ordering or fabricating the material.

D Measurement

The City of Madison will measure each campus railing by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.013	Campus Railing	LF

Payment is full compensation for all materials, shop drawings, labor and incidentals for constructing the railing, in accordance with the drawings and as set forth in these specifications.

10-15 Concrete Gutter 12-Inch, SPV.0090.014.

A Description

This special provision describes the construction of an integral gutter.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans and in accordance with standard spec 601.

Construct Concrete Gutter 12-Inch integrally with the pavement.

D Measurement

The City of Madison will measure Construct Concrete Gutter 12-Inch by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.014	Concrete Gutter 12-Inch	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-16 Concrete Curb & Gutter Integral 24-Inch Type J (Mountable), SPV.0090.016.

A Description

This special provision describes the construction of a mountable curb and gutter.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans, as shown in the construction detail drawing, and in accordance with standard spec 601.

D Measurement

The City of Madison will measure Concrete Curb & Gutter Integral Type J (Mountable) by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.016	Concrete Curb & Gutter Integral 24-Inch Type J (Mountable)	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-17 Concrete Curb and Gutter Integral 18-Inch Special, SPV.0090.017.

A Description

This special provision describes the construction of a City of Madison standard curb and gutter.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans, as shown on City of Madison standard detail drawings for Type G curb, and paved integrally with the adjacent concrete pavement in accordance with WisDOT standard spec 601.

D Measurement

The City of Madison will measure Concrete Curb & Gutter Integral 24-Inch Special by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.017	Concrete Curb & Gutter Integral 18-Inch Special	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-18 Concrete Curb & Gutter 24-Inch Type A, SPV.0090.018.

A Description

This special provision describes the construction of a City of Madison standard curb and gutter.

B (Vacant)

C Construction

Construct concrete curb and gutter as shown in the plans, as shown in the construction detail drawing , as shown on City of Madison standard detail drawing, and in accordance with WisDOT standard spec 601.

D Measurement

The City of Madison will measure Concrete Curb & Gutter 24-Inch Type A by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.018	Concrete Curb & Gutter 24-Inch Type A	LF

Payment is full compensation for all materials, labor and incidentals for constructing the curb and gutter, in accordance with the drawings and as set forth in these specifications.

10-19 Reinstall Salvaged Fence, SPV.0090.019.

A Description

This special provision describes reinstalling salvaged median fence as shown in the plans.

B Materials

Conform to section 501 of the standard specifications for concrete. Furnish grade A concrete as modified in section 716 of the standard specifications, except the engineer may waive the requirements for proportioning by weight, and may allow alternate mixers or mixing methods.

The existing fence at Marquette Street is Black Elite Aluminum Fence EFF-20 originally supplied by Discount Fence Supply, Inc.

C Construction

As applicable, install per manufacturer's instructions. Construct concrete footings as shown in the plans. Locate the concrete footing to allow centering of the salvaged post. In firm ground, excavate holes for the footings to the neat dimensions and place concrete directly in the excavation. Remove rock or other obstructions encountered in the excavation to the required depth. If unstable soils or other areas prevent making footing excavation to neat dimensions, use forms. Keep the form in place until the concrete cures for at least 24 hours. After removing the form, backfill the footing with suitable material. Ensure the backfill material has the correct moisture content for compacting and place and compact in layers. Attach the salvaged post and flange to the concrete footing or concrete sidewalk 7-Inch using adhesive anchors 5/8-inch as shown in the plans.

D Measurement

The City of Madison will measure Reinstall Salvaged Fence in linear feet, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.019	Reinstall Salvaged Fence	LF

Payment is full compensation for procurement, delivery, and installation of salvaged fence as set forth in these specifications including excavation, concrete footings, adhesive anchors, forming as required, and backfilling.

10-20 C1 Concrete Sidewalk 7-Inch, Item SPV.0165.001.

A Description

This special provision describes the constructing of concrete sidewalk as shown in the plans and in accordance with Article 303.2(p) of the City of Madison standard specifications.

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure C1 Concrete Sidewalk 7-Inch by the square foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0165.001	C1 Concrete Sidewalk 7-Inch	SF

Payment is full compensation for all materials, labor and incidentals for constructing the sidewalk, in accordance with the drawings and as set forth in these specifications.

10-21 Brick Pavers on Concrete Base, SPV.0165.002.

A Description

This special provision describes installing brick pavers at the locations indicated on the plans.

The pavers are to be installed per the detail drawings. All base materials, including crushed stone, concrete sidewalk and asphalt settling bed shall be considered incidental to this bid item.

B Materials

Brick pavers shall match the size and color of the pavers recently installed immediately to the west, which were Unilock, Hollandstone 4x8 pavers, or approved equal.

Asphalt setting bed shall comply with standard specifications, and as follows: Coarse to fine sand aggregates, 7% Asphalt content, 82 Lbs./sq. yd., ¾" thick.

Neoprene-Modified asphalt adhesive:

Mastic: (asphalt adhesive: Karnak #230 2%Neo-asphalt, or as approved by engineer)

Solids (base)	75 + 1%
Lbs./Gal.	8-8.5 lbs.
Solvent	Varsol (over 100 deg. F. flash)

Base: (2% neoprene, 10% fibers, 88% asphalt)

Melting point – ASTM D-36	200 deg. F. Minimum

Penetration – 77 deg. F 100 gram load

5 second (.1 m.m.)	23-27

Ductility – ASTM D-133-44

Concrete sub-slab shall comply with standard specification for 7-Inch Concrete Sidewalk.

Joint filler shall be polymeric sand. Contractor shall provide application instructions and sample for approval by engineer prior to installation. Apply per manufacturer instructions. Furnish materials that meet the requirements specified in City of Madison standard spec 301.8 and WisDOT standard spec 415.3.13.2.

C Construction

The contractor shall excavate the area to appropriate depth as shown on the detail drawings and place and compact the crushed aggregate gradation 3 base material. Install concrete sub-slab per the specifications for 7-Inch Concrete Sidewalk.

To install pavers, place ¾" deep control bars directly over the concrete sub-slab. Adjust to proper grade. Set two bars parallel to each other approximately 11 feet apart to serve as guides for a striking board 12 ft. in length. The depth control bars shall be set carefully to bring the pavers when laid to proper grade.

Place asphalt setting bed between control bars. Pull this bed with the striking board over the bars several times. After each passage, low porous spots shall be showered with fresh asphalt material to produce a smooth, firm and even setting bed. Carefully fill depressions that remain after removing the depth control bars.

The setting bed shall be rolled to a nominal depth of ¾" while still hot. The thickness shall be adjusted so that the pavers will be at the required finished grade.

A coating of 2% neoprene-modified asphalt adhesive shall be applied over the top surface of the asphalt setting bed. Squeegee or trowel over top surface. Trowel serrations shall not exceed 1/16" in height.

Lay pavers to match the pattern that was established by the previous project immediately to the west of the pavers being installed under this contract.

In all cases, joints shall not exceed 1/8". To obtain a smooth even surface, cover pavers with ½" plywood or other sheathing and roll with roller to level paver surface. After final compaction, surface shall be flush with adjacent surfaces, true to grade, and shall not vary by more than ¼" when tested with a 10' straight edge in any location. Polymeric sand mixture shall be placed directly into joints until completely filled. All openings over 3/16" shall be filled. Remove excess material and clean surface.

Within the area of the pavers, concrete pads will need to be installed for setting of parking stall markers and street signs. The contractor shall coordinate with City Traffic Engineering and City Parking Utility to determine the final location of these concrete pads. Each pad shall be 18"x18" and must be level with the top surface of the pavers. The concrete pads shall be formed and poured with the concrete base for the pavers, and the pads will be measured and paid as part of the measured area of the brick pavers.

D Measurement

The City of Madison will measure Brick Pavers on Concrete Base by the square foot, removed, installed and accepted in place, including concrete pads for parking stall markers and signs.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0165.002	Brick Pavers on Concrete Base	SF

Payment is full compensation for removing and salvaging existing pavers, removing base materials as necessary, and reinstalling pavers including subgrade preparation, concrete sub-slab, asphalt setting bed; and for furnishing all labor, tools, equipment and incidentals necessary to complete this item of work.

11. Station Platform and Shelter.

11-1 Bike Rack, Item SPV.0060.003.

A Description

This special provision describes furnishing and installing a bike rack at the locations as indicated on the plan.

B Materials

Bike rack shall be stainless steel U square rails for 2 bicycles. Bike rack shall be:

"SBR11B" model by Duo-Gard Industries Inc., 40442 Koppernick Road, Canton, Michigan 48187. Phone (734) 207-9700. Web Site www.duo-gard.com E-Mail info@duo-gard.com or Approved equal.

C Construction

Submit Manufacturer's product data and shop drawings for bicycle rail and installation including: Layout, footing and installation details. Examine footing with the installer, present for compliance with requirements indicated, installation tolerances and other conditions that affect the installation of all bicycle rails such as aisle widths. Correct unsatisfactory conditions before proceeding with the installation. Setout as per manufacturer's recommendations and guidelines

Install bicycle rail and associated components in accordance with manufacturer's. Verify units level, plumb and true line.

D Measurement

The City of Madison will measure Bike Rack by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.003	Bike Rack	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

11-2 Platform Electrical Cabinet, Item SPV.0060.301.

A Description

This special provision describes furnishing and installing electrical cabinets at station locations as indicated in the plans. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
262716 Electrical Cabinets and Enclosures

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Station Electrical Cabinet under this section as each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.301	Platform Electrical Cabinet	EACH

Payment is full compensation for furnishing and installing the platform electrical cabinet including enclosure, interior lighting, circuit wiring connections, mounting hardware, fittings, and all incidental items required for a finished and complete installation as indicated on the plans.

11-3 Platform Communication Cabinet, Item SPV.0060.302.

A Description

This special provision describes furnishing and installing a communications cabinet at station locations as indicated in the plans. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
262716 Electrical Cabinets and Enclosures

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Station Communication Cabinet under this section as each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.302	Platform Communication Cabinet	EACH

Payment is full compensation for furnishing and installing the platform communication cabinet including enclosure, interior lighting, circuit wiring connections, mounting hardware, fittings, and all incidental items required for a finished and complete installation as indicated on the plans.

11-4 Bid Alternate 1: Snow Melt System Shelter Type A1, Item SPV.0060.303; Snow Melt System Shelter Type A2, Item SPV.0060.304; Snow Melt System Shelter Type A3, Item SPV.0060.305; Snow Melt System Shelter Type A4, Item SPV.0060.306; Snow Melt System Shelter Type A5, Item SPV.0060.307; Snow Melt System Shelter Type A6, Item SPV.0060.308; Snow Melt System Shelter Type A7, Item SPV.0060.309; Station Snow Melt System Shelter Type B1, Item SPV.0060.311; Station Snow Melt System Shelter Type B2, Item SPV.0060.312; Station Snow Melt System Shelter Type C, Item SPV.0060.315.

A Description

This special provision describes furnishing all materials, equipment, and labor to install a station electrical snow melt system as shown on the plans and as specified herein. Snow melt system equipment to include, but not limited to, the platform snow melt system; remote control system provisions at platform; snow melt system controls and sensors, control panel; conduit and pull boxes; caution signage; wire, cable, and terminations.

B Materials

B.1 Submittals

Submit Product Data Sheets on the following items:

1. Platform snow melt system data sheets.
2. Snow melt control system, wiring diagram, and enclosure.
3. Snow melt system installation details.
4. Platform pull boxes.

Submit Drawings with locations and layout of snow melt systems, including zones, cable routing, component locations, expansion joints, sections, and attachment details.

Submit Calculations for power consumptions for the heat dissipation of the platform snow melt system by zone. Include rated capacities, length of cable, operating characteristics, controller wiring diagram.

Submit Operations and Maintenance Manual Test Results and Product Warranty in accordance with the requirements of the special provisions.

Warranty: Manufacturer agrees to repair or replace components of the snow melt system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

B.2 Conductors and Cabling

Wiring to be detailed in the shop drawings. Provide conductors and cables in accordance with WisDOT with standard specifications.

B.3 Conduit

Conduit locations and material to be detailed in the shop drawings. Provide conduit in accordance with WisDOT standard specifications.

B.4 Grounding

Grounding to be detailed in the shop drawings. Grounding requirements to be in accordance WisDOT with standard specifications.

B.5 Platform Snow Melt System

Design, furnish and install a complete electric snow melting system by nVent Raychem or approved equal, as shown in the contract plans and described in these specifications. The complete system will comprise of heating elements, control sensors, relays and contractors, hot/cold cable splices, power supply cable from the control equipment mounted in the station power control cabinet and control cables from the control sensor to the control equipment and all else necessary to make up a fully functional snow melting system. Equipment shall be UL listed specifically for de-icing and snow melting and conform to the requirements of IEEE Standard 515.1.

The snow melt system shall be designed to have a minimum of two (2) zones covering the areas of snow melt shown in the plans. The primary zone(s) shall be along the platform edge where riders board the bus. This zone has specific dimensions provided in the plans for each shelter type where riders board the bus. The secondary zone(s) shall cover the remaining areas as shown on the plans. Zones shall be established with consideration made to the potential of secondary zone(s) being turned down or off to reduce operating costs. Limit total number of zones (primary & secondary combined) to a maximum of (6) six per shelter.

The heating elements will be single cable with a self-regulating conductive polymer core and copper bus conductors. Cables shall be able to be field cut and spliced. Cables to be rated for either 208V or 240V operation as required per plans.

The heating element will be powered as indicated on the plans and shall be designed to provide a nominal heat density of 40 watt per square foot.

The control sensors shall be both, an in-ground type housed in the concrete slab and air sensor which will both be capable of detecting the appropriate conditions of both temperature and moisture that indicate the formation of ice or snow on the ground. Provide a minimum of two (2) pavement sensors, one for each side of station.

The snow melt controller/relay panel dimensions shall not exceed an area of 20”W x 36”H x 6”D and must fit within the electrical cabinet as shown in the plans.

The snow melt controller shall be equipped with contact closure Override On and Override Off inputs. Override On causes heater operation and Override Off inhibits heater operation. With no contact closures to either of the two inputs the heaters shall be controlled based on environmental conditions.

Pull boxes to be Quazite “PC” style polymer concrete enclosures with open bottom or approved equal. Pull box interior dimension shall not be larger than 12” x 12”. Provide weatherproof, gasketed non-skid cover with stainless steel Penta head bolts. Cover logo “ELECTRIC”. Provide ½” PVC conduit in base of pull box for drainage.

System Performance:

1. Heat requirements shall be determined from recommendations in the ASHRAE Handbook and / or IEEE Standard 515.1 for a performance classification of Class II (moderate) in a non-critical application. Heater design and selection will be based upon the desired heat load in accordance with the manufacturers published specifications and guidelines.
2. System power output shall confirm to ASHRAE/IEEE 515.1recommendations under steady state conditions.

Basis of Design: nVent Thermal Management, or approved equal

C Construction

Install snow melt system at the locations shown on the plans per manufacturer’s written recommendations and according to WisDOT standard specification. All necessary trenching, paving, cutting, excavation, backfilling and restoration of the site, paved surfaces, walks, etc., in connection with the work in this section shall be included and shall conform to the requirements of the current WisDOT standard specifications.

Do not run heating elements (hot leads) directly into electrical cabinet. Make power connection to heating element within a pull box outside of the cabinet and terminate the power connection cold leads at the control panel.

D Measurement

The City of Madison will measure Station Snow Melt System under this section as each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.303	Station Snow Melt System Shelter Type A1	Each
SPV.0060.304	Station Snow Melt System Shelter Type A2	Each
SPV.0060.305	Station Snow Melt System Shelter Type A3	Each
SPV.0060.306	Station Snow Melt System Shelter Type A4	Each
SPV.0060.307	Station Snow Melt System Shelter Type A5	Each
SPV.0060.308	Station Snow Melt System Shelter Type A6	Each
SPV.0060.309	Station Snow Melt System Shelter Type A7	Each
SPV.0060.311	Station Snow Melt System Shelter Type B1	Each
SPV.0060.312	Station Snow Melt System Shelter Type B2	Each
SPV.0060.315	Station Snow Melt System Shelter Type C	Each

Payment is full compensation for furnishing and installing the station snow melt system including heating elements, control sensors, relays and contactors, hot/cold cable splices, control panel, circuit wiring connections, pull boxes, mounting hardware, fittings, and all incidental items required for a finished and complete installation as indicated on the plans.

11-5 Reinforced Concrete Platform Type A1, Item SPV.0060.401; Reinforced Concrete Platform Type A2, Item SPV.0060.402; Reinforced Concrete Platform Type A3, Item SPV.0060.403; Reinforced Concrete Platform Type A4, Item SPV.0060.404; Reinforced Concrete Platform Type A5, Item SPV.0060.405; Reinforced Concrete Platform Type A6, Item SPV.0060.406; Reinforced Concrete Platform Type A7, Item SPV.0060.407; Reinforced Concrete Platform Type B1, Item SPV.0060.409; Reinforced Concrete Platform Type B2, Item SPV.0060.410; Reinforced Concrete Platform Type C, Item SPV.0060.413; Reinforced Concrete Platform without a Canopy, Item SPV.0060.448.

A Description

This special provision describes the construction of the station platforms at the locations as indicated in the plans. See drawings and Architectural Special Provisions Package 1. Scope includes, but is not limited to, the following sections:

012300 Alternates
012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
031000 Concrete Forming and Accessories
032000 Concrete Reinforcing
033000 Cast-In-Place Concrete
055000 Metal Fabrications (Abrasive Nosings)

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each reinforced concrete platform completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.401	Reinforced Concrete Platform Type A1	EACH
SPV.0060.402	Reinforced Concrete Platform Type A2	EACH
SPV.0060.403	Reinforced Concrete Platform Type A3	EACH
SPV.0060.404	Reinforced Concrete Platform Type A4	EACH
SPV.0060.405	Reinforced Concrete Platform Type A5	EACH
SPV.0060.406	Reinforced Concrete Platform Type A6	EACH
SPV.0060.407	Reinforced Concrete Platform Type A7	EACH
SPV.0060.409	Reinforced Concrete Platform Type B1	EACH
SPV.0060.410	Reinforced Concrete Platform Type B2	EACH
SPV.0060.413	Reinforced Concrete Platform Type C	EACH
SPV.0060.448	Reinforced Concrete Platform without a Canopy	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the reinforced concrete platform, including reinforced concrete topping slab, knee wall, abrasive nosings, detectable warning field and directional tile in accordance with the drawings and as set forth in these specifications. Excavation, sloped sidewalk, docking guide strip, median maintenance area, and base aggregate are not included in the payment of the Reinforced Concrete Platform bid items.

11-6 Platform Shelter Type A1, Item SPV.0060.417; Platform Shelter Type A2, Item SPV.0060.418; Platform Shelter Type A3, Item SPV.0060.419; Platform Shelter Type A4, Item SPV.0060.420; Platform Shelter Type A5, Item SPV.0060.421; Platform Shelter Type A6, Item SPV.0060.422; Platform Shelter Type A7, Item SPV.0060.423; Platform Shelter Type B1, Item SPV.0060.425; Platform Shelter Type B2, Item SPV.0060.426; Platform Shelter Type C, Item SPV.0060.429.

A Description

This special provision describes the fabrication and installation of the station shelters at the locations as indicated in the plans. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012300 Alternates
012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
051200 Structural Steel Framing
051213 Architecturally Exposed Structural Steel Framing
053100 Steel Decking
054000 Cold-Formed Metal Framing
055000 Metal Fabrications (Miscellaneous framing and supports)
061000 Rough Carpentry
061600 Sheathing
074213.13Formed Metal Wall Panels
074243 Composite Wall and Soffit Panels
075423 Thermoplastic-Polyolefin (TPO) Roofing
076200 Sheet Metal Flashing and Trim
079200 Joint Sealants
084313 Aluminum-Framed Storefronts
086300 Metal-Framed Skylights
088000 Glazing
099600 High-Performance Coatings
108113 Bird Control Devices
126723 Benches
238300 Radiant Heaters

260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems
260572 Overcurrent Protective Device Short-Circuit Study
260573 Overcurrent Protective Device Coordination Study
260574 Overcurrent Protective Device Arc-Flash Study
260923 Lighting Control Devices
260943 Relay-Based Lighting Controls
262416 Panelboards
262726 Wiring Devices
262813 Fuses
264313 Surge Protection for Low-Voltage Electrical Power Circuits
265600 Exterior Lighting

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each platform shelter completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.417	Platform Shelter Type A1	EACH
SPV.0060.418	Platform Shelter Type A2	EACH
SPV.0060.419	Platform Shelter Type A3	EACH
SPV.0060.420	Platform Shelter Type A4	EACH
SPV.0060.421	Platform Shelter Type A5	EACH
SPV.0060.422	Platform Shelter Type A6	EACH
SPV.0060.423	Platform Shelter Type A7	EACH
SPV.0060.425	Platform Shelter Type B1	EACH
SPV.0060.426	Platform Shelter Type B2	EACH
SPV.0060.429	Platform Shelter Type C	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the shelter, including canopy, heaters, lean rails, benches, crescent wall, planter, platform sign, trash cans, light fixtures, stair, and bird control devices in accordance with the drawings and as set forth in these specifications. Electrical and communications cabinet, pedestrian handrail, fare vending machine(by others), security cameras (by others), speakers (by others), real time signs and push button (by others), antenna (by others), modem (by others), and DVR (by others) not included in payment of the Platform Shelter bid items.

11-7 Bike Shelter, Item SPV.0060.431.

A Description

This special provision describes furnishing and installing a bike shelter at the location as indicated on the plan.

B Materials

“Parachute” model, 12’ x 13’ by Duo-Gard Industries Inc., 40442 Koppernick Road, Canton, Michigan 48187. Phone (734) 207-9700. Web Site www.duo-gard.com E-Mail info@duo-gard.com or Approved equal.

C Construction

Submit manufacturer's shop drawings, including plans, elevations, sections and details, dimensions, anchorage, fasteners and locations, flashing, seal details, color, finish, and erection procedures to enable field installation. Installation shall be performed by the manufacturer or his representative.

D Measurement

The City of Madison will measure Bike Shelter by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.431	Bike Shelter	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

11-8 Docking Guide Strip, Item SPV.0090.011.

A Description

This special provision describes furnishing and installing a guide strip onto the station platforms as indicated in the plans. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
321613.19 Docking Guide Strip

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each docking guide strips by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.011	Docking Guide Strip	LF

Payment is full compensation for procurement and installation of Docking Guide Strip, backer boards and anchorage as set forth in these specifications.

11-9 Pedestrian Handrail, Item SPV.0090.401.

A Description

This special provision describes furnishing and installing the handrail at locations shown in the plans. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
055213 Pipe and Tube Railings

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each pedestrian handrail by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.401	Pedestrian Handrail	LF

Payment is full compensation for procurement, delivery, and installation of Pedestrian Handrail to the City of Madison maintenance facility as set forth in these specifications.

11-10 Railing Steel Special, Item SPV.0090.402.

A Description

This special provision describes providing railing in accordance with the construction detail and with standard spec 513.

B (Vacant)

C Construction

Construct railing as shown in the plans and in accordance with standard spec 513.

D Measurement

The City of Madison will measure each railing steel special by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.402	Railing Steel Special	LF

Payment is full compensation for procurement, delivery, and installation of railing steel special as set forth in these specifications.

11-11 Concrete Sloped Walkway, Item SPV.0165.401.

A Description

This special provision describes the construction of the concrete sloped walkway located adjacent to the platform as detailed in the plans.

B.1 General

Furnish materials in compliance with standard spec 602.2.

C Construction

Prepare foundation, install forms, place concrete, construct joints, finish concrete, and cure concrete in compliance with standard spec 602.3.

D Measurement

The City of Madison will measure Concrete Sloped Walkway by the square foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0165.401	Concrete Sloped Walkway	SF

Payment is full compensation for all materials, labor and incidentals for constructing the sloped sidewalk, in accordance with the drawings and as set forth in these specifications.

12. Accessory Structures.

12-1 Junction Road Restroom and Electrical Building, Item SPV.0060.414; Sun Prairie Restroom and Electrical Building, Item SPV.0060.449.

A Description

This special provision describes the construction of buildings as shown in the plans. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
031000 Concrete Forming and Accessories
032000 Concrete Reinforcing
033000 Cast-In-Place Concrete
042000 Unit Masonry
051200 Structural Steel Framing
053100 Steel Decking
054000 Cold-Formed Metal Framing
057000 Decorative Metal
061000 Rough Carpentry
061600 Sheathing
071416 Cold-Fluid Applied Waterproofing
072100 Thermal Insulation
072726 Fluid-Applied Membrane Air Barriers
075423 Thermoplastic-Polyolefin (TPO) Roofing
076200 Sheet Metal Flashing and Trim
078400 Joint Firestopping
079200 Joint Sealants
081113 Hollow Metal Doors and Frames
083113 Access Doors and Frames
087100 Door Hardware
092216 Non-Structural Metal Framing
092900 Gypsum Board
099123 Interior Painting
099600 High-Performance Coatings
102800 Toilet, Bath, And Laundry Accessories
104416 Fire Extinguishers
230000 Mechanical and Plumbing for Comfort Station
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems
260572 Overcurrent Protective Device Short-Circuit Study
260573 Overcurrent Protective Device Coordination Study
260574 Overcurrent Protective Device Arc-Flash Study
260923 Lighting Control Devices
260943 Relay-Based Lighting Controls
262200 Low-Voltage Transformers
262413 Switchboards
262416 Panelboards

262726 Wiring Devices
262813 Fuses
262816 Enclosed Switches and Circuit Breakers
262913 Enclosed Controllers
264313 Surge Protection for Low-Voltage Electrical Power Circuits
265119 Led Interior Lighting
265219 Emergency and Exit Lighting
265600 Exterior Lighting

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each building completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.414	Junction Road Restroom and Electrical Building	EACH
SPV.0060.449	Sun Prairie Restroom and Electrical Building	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the building, including Architectural elements, Structural elements, 2000-amp Electrical system, Mechanical system, and Plumbing system in accordance with the Junction Road Restroom and Electrical Building drawings and as set forth in these specifications. Junction Road Park and Ride parking lot lighting, Site Electrical, and Utility Electrical Service not included in payment of the Junction Road Restroom and Electrical Building bid item.

Payment is full compensation for all materials, labor and incidentals for constructing the building, including Architectural elements, Structural elements, 800-amp Electrical system, Mechanical system, and Plumbing system in accordance with the Sun Prairie Restroom and Electrical Building drawings and as set forth in these specifications. Sun Prairie Site Electrical and Utility Electrical Service not included in payment of the Sun Prairie Restroom and Electrical Building bid item.

12-2 Hanson Road Electrical Building, Item SPV.0060.415.

A Description

This special provision describes the construction of a building at 3901 Hanson Road as shown in the plans. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
031000 Concrete Forming and Accessories
032000 Concrete Reinforcing
033000 Cast-In-Place Concrete
042000 Unit Masonry
051200 Structural Steel Framing
053100 Steel Decking
054000 Cold-Formed Metal Framing
061000 Rough Carpentry
061600 Sheathing
071416 Cold-Fluid Applied Waterproofing
072100 Thermal Insulation
072726 Fluid-Applied Membrane Air Barriers
075423 Thermoplastic-Polyolefin (TPO) Roofing
076200 Sheet Metal Flashing and Trim

078400 Joint Firestopping
079200 Joint Sealants
081113 Hollow Metal Doors and Frames
083113 Access Doors and Frames
087100 Door Hardware
099123 Interior Painting
099600 High-Performance Coatings
104416 Fire Extinguishers
230000 Mechanical and Plumbing for Comfort Station
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems
260572 Overcurrent Protective Device Short-Circuit Study
260573 Overcurrent Protective Device Coordination Study
260574 Overcurrent Protective Device Arc-Flash Study
260923 Lighting Control Devices
260943 Relay-Based Lighting Controls
262200 Low-Voltage Transformers
262413 Switchboards
262416 Panelboards
262726 Wiring Devices
262813 Fuses
262816 Enclosed Switches and Circuit Breakers
262913 Enclosed Controllers
264313 Surge Protection for Low-Voltage Electrical Power Circuits
265119 Led Interior Lighting
265219 Emergency and Exit Lighting
265600 Exterior Lighting

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each building completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.415	Hanson Road Electrical Building	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the building, including Architectural elements, Structural elements, 800-amp Electrical system, Mechanical system, and Plumbing system in accordance with the Hanson Road Electrical Building drawings and as set forth in these specifications. Hanson Maintenance Facility Electrical Improvements and Site Electrical not included in payment of the Hanson Road Electrical Building bid item.

12-3 Overhead Charger Foundation, Item SPV.0060.416.

A Description

This special provision describes the construction of foundations to be used for overhead 450 kW chargers at the Junction Road Park and Ride, 3901 Hanson Road, and the Sun Prairie Park and Ride as shown in the plans. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures

014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
031000 Concrete Forming and Accessories
032000 Concrete Reinforcing
033000 Cast-In-Place Concrete

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure each foundation completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.416	Overhead Charger Foundation	EACH

Payment is full compensation for all materials, labor and incidentals for constructing the foundation, in accordance with the drawings and as set forth in these specifications.

12-4 Install Metro Local Route Shelter, SPV.0060.433.

A Description

This special provision describes the installation of Metro provided bus shelters at the Junction Road terminal.

B Materials

Obtain shelter from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install only after coordination with Metro. Install shelters according to manufacturer's instructions, and as shown in the plans. Install electrical connection to shelter.

D Measurement

The City of Madison will measure Install Metro Local Route Shelter by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.433	Install Metro Local Route Shelter	EACH

Payment is full compensation for picking up, transporting, and installing shelters at the Junction Road terminal.

12-5 Wall Modular Block Gravity Landscape (Portage), Item SPV.0165.402; Wall Modular Block Gravity Landscape (Independence), Item SPV.0165.403

A Description

This special provision describes designing, furnishing materials and erecting a permanent earth retention system according to the lines, dimension, elevations and details as shown on the plans and provided in the contract. The design life of the wall and all wall components shall be 75 years minimum.

B Materials

B.1 Proprietary Wall Systems

The supplied wall system must be from the Wisconsin Department of Transportation (WisDOT) approved list of Modular Block Gravity Landscape Wall systems. Proprietary wall systems must conform to the requirements of this specification and be pre-approved for use by WisDOT Bureau of Structures. WisDOT maintains a list of pre-approved proprietary wall systems. See the approved products list titled “Proprietary Retaining Wall System Vendors.” The name of the pre-approved proprietary wall system selected shall be furnished to the engineer within 25 days after the award of contract. WisDOT also maintains a separate list of plants pre-approved by WisDOT to provide wall facing units. See the approved products list titled “Precast Concrete and Block Fabricators.” The identity of the plant manufacturing the facing units shall be furnished to the engineer at least fourteen days prior to the project delivery.

To be eligible for use on this project, a system must have been pre-approved by the Bureau of Structures and added to that list prior to the bid closing date. To receive pre-approval, the retaining wall system must comply with all pertinent requirements of this provision and be prepared according to the requirements of Chapter 14 of WisDOT’s LRFD Bridge Manual. Information and assistance with the pre-approval process can be obtained by contacting the Bureau of Structures, Structures Maintenance Section at the following email address: DOTDLStructuresFabrication@dot.wi.gov.

To be eligible to provide wall facing units for this project, a block manufacturing plant must be pre-approved by the Bureau of Technical Services and added to that list prior to the bid closing date. Information and assistance with the pre-approval process can be obtained by contacting the Bureau of Technical Services at the following email address: DOTProductSubmittal@wisconsin.gov.

B.2 Design Requirements

It is the responsibility of the contractor to submit a design and supporting documentation as required by this special provision, for review and acceptance by the engineer, to show the proposed wall design conforms to the design specifications. The submittal shall include the following items for review: detailed plans and shop drawings, complete design calculations, explanatory notes, supporting materials, and specifications. The detailed plans and shop drawings shall include all details, dimensions, quantities and cross-sections necessary to construct the walls. Submit shop drawings to the engineer conforming to 105.2 with electronic submittal to the fabrication library under 105.2.2. Certify that shop drawings conform to quality control standards by submitting WisDOT form DT2329 with each set of shop drawings. Engineer review does not relieve the contractor from responsibility for errors or omissions on shop drawings. Submit no later than 60 days from the date of notification to proceed with the project and a minimum of 30 days prior to the date proposed to begin wall construction.

The plans and shop drawings shall be prepared on reproducible sheets 11 inch x 17 inch, including borders. Each sheet shall have a title block in the lower right corner. The title block shall include the project identification number. Design calculations and notes shall be on 8 ½ inch x 11 inch sheets, and shall contain the project identification number, name or designation of the wall, date of preparation, initials of designer and checker, and page number at the top of the page. All plans, shop drawings, and calculations shall be signed, sealed and dated by a professional engineer licensed in the State of Wisconsin.

The design of the wall shall be in compliance with the current American Association of State Highway and Transportation Officials LRFD (AASHTO LRFD) Bridge Design specifications with latest interim specifications for Mechanically Stabilized Earth Walls, WisDOT’s current standard specifications for Highway and Structure Construction (standard spec), Chapter 14 of the WisDOT LRFD Bridge Manual and standard engineering design procedures as determined by WisDOT. Loads, load combinations, load and resistance factors shall be as specified in AASHTO LRFD Section 11. The associated resistance factors shall be defined according to Table 11.5.7-1 in AASHTO LRFD.

Design and construct the walls according to the lines, grades, heights and dimensions shown on the plans, as herein specified, and as directed by the engineer.

Walls shall be designed for a minimum live load surcharge of 100 psf according to Chapter 14 of the WisDOT LRFD Bridge Manual or as shown on the plans.

A maximum value of the angle of internal friction of the wall backfill material used for design shall be assumed to be 30 degrees without a certified report of tests. If a certified report of tests yields an angle of internal friction greater than 30 degrees, the larger test value may be used for design, up to a maximum value of 36 degrees.

The design of the wall by the contractor shall consider the internal and compound stability of the wall mass according to AASHTO LRFD 11.10.6. Internal stability shall also be considered at each block level.

Calculations for factored stresses and resistances shall be based upon assumed conditions at the end of the design life. The width of the modular block (front face to back face) shall be included in the design computations and shown on the wall shop drawings. Blocks must have a minimum width of 8 inches. Block widths may vary among courses, but shall consist of only a single block. Compound stability shall be computed for the applicable strength limits. Sample analyses and hand calculations shall be submitted to verify the output of any software program used. The design calculations and notes shall clearly indicate the Capacity to Demand Ratios (CDR) for all internal and external stabilities as defined in AASHTO LRFD.

Wall facing units shall be designed according to AASHTO LRFD 11.10.2.3.

The minimum embedment of the wall shall be 1 foot 6 inches below finished grade, or as given on the plans. All walls shall be provided with a concrete or base aggregate leveling pad. Minimum wall embedment does not include the leveling pad depth. Step the leveling pad to follow the general slope of the ground line. Frost depth shall not be considered in designing the wall for depth of leveling pad.

Wall facing units shall be installed on a leveling pad.

B.3 Wall System Components

Materials furnished for wall system components under this contract shall conform to the requirements of this specification. All documentation related to material and components of the wall systems specified in this subsection shall be submitted to the engineer.

B.3.1 Wall Facing

Wall facing units shall consist of precast modular concrete blocks. Furnish concrete produced by a dry-cast or wet-cast process. Concrete for all blocks shall not contain less than 565 pounds of cementitious materials per cubic yard. The contractor may use cement conforming to standard spec. 501.2.1 or may substitute for Portland cement at the time of batching conforming to standard spec. 501.2.6 for fly, 501.2.7 for slag, or 501.2.8 for other pozzolans. In either case the maximum total supplementary cementitious content is limited to 30% of the total cementitious content by weight.

Dry-cast concrete blocks shall be manufactured according to ASTM C1372 and this specification.

All units shall incorporate a mechanism or devices that develop a mechanical connection between vertical block layers. Units that are broken, have cracks wider than 0.02” and longer than 25% of the nominal height of the unit, chips larger than 1”, have excessive efflorescence, or are otherwise deemed unacceptable by the engineer, shall not be used within the wall. A single block front face style shall be used throughout each wall. The color and surface texture of the block shall be as given on the plan.

The top course of facing units shall be as noted on the plans, either:

- Solid precast concrete unit designed to be compatible with the remainder of the wall. The finishing course shall be bonded to the underlying facing units with a durable, high strength, flexible adhesive compound compatible with the block material.
- A formed cast-in-place concrete cap. A cap of this type shall have texture, color, and appearance, as noted on the plans. The vertical dimension of the cap shall not be less than 3 1/2 inches. Expansion joints shall be placed in the cap at a maximum spacing of 20 feet unless noted otherwise on the plan. Use Grade A, A-FA, A-S, A-T, A-IS, A-IP or A-IT concrete conforming to standard spec 501 as modified in standard spec 716. Provide QMP for cast in place cap and coping concrete as specified in standard spec 716, Class II Concrete.

Block dimensions may vary no more than ±1/8 inch from the standard values published by the manufacturer. Blocks must have a minimum width (front face to back face) of 8 inches. The minimum front face thickness of blocks shall be 4 inches measured perpendicular from the front face to inside voids greater than 4 square inches. The minimum allowed thickness of any other portions of the block is 1¾ inches. The front face of the blocks shall conform to plan requirements for color, texture, or patterns.

If pins are used to align modular block facing units, they shall consist of a non-degrading polymer, or hot dipping galvanized steel and be made for the express use with the modular block units supplied, to develop mechanical interlock between facing unit block layers. Connecting pins shall be capable of holding the wall in the proper position during backfilling. Furnish documentation that establishes and substantiates the design life of such devices.

All block materials shall be furnished palleted and banded, with every pallet marked for quantity, lot number, lot size, manufacturing plant, and manufacturing date(s). Materials furnished loose or unmarked will be rejected. Rejected materials shall be removed from the project at no cost to the City of Madison.

B.3.1.1 Material Testing

Perform or procure quality control testing of project materials according to the following requirements:

Test	Method	Requirement	
		Dry-cast	Wet-cast
Compressive Strength (psi)	ASTM C140 or ASTM C39 [4]	5000 min.	4000 min.
Air Content (%)	AASHTO T152 [4]	N/A	6.0 +/-1.5
Water Absorption (%)	ASTM C140 [3]	6 max.	N/A
Freeze-Thaw Loss (%) 40 cycles, 5 of 5 samples 50 cycles, 4 of 5 samples	ASTM C1262[1][2][3]	 1.0 max. 1.5 max.	N/A

[1] Test shall be run using a 3% saline solution and blocks greater than 45 days old.

[2] Test results that meet either of the listed requirements for Freeze-Thaw Loss are acceptable.

[3] An independent testing laboratory shall control and conduct all sampling and testing under ASTM C140/Water Absorption and ASTM C1262. Prior to sampling, the manufacturer shall identify materials by lot. Five blocks per lot shall be randomly selected for testing. Solid blocks used as a finishing or top course shall not be selected. The selected blocks shall remain under the control of the person who conducted the sampling until shipped or delivered to the testing laboratory.

[4] The manufacturer may perform their own quality control testing under ASTM C140/Compressive Strength, ASTM C39, and AASHTO T152, if qualified for this work under the requirements for plant certification.

The contractor and fabricator shall coordinate with the independent testing agent (if used) to ensure that strength and air content samples can be taken appropriately during manufacturing. At the time of delivery of materials, furnish the engineer a certified report of test from an AASHTO-registered or ASTM-accredited independent testing laboratory for each lot furnished.

The certified test report shall include the following:

- Project ID
- Production process used (dry-cast or wet-cast)
- Name and location of testing facility
- Name of sampling technician
- Lot number, lot size, and date(s) of fabrication

Quality control testing of project materials shall be completed not more than 18 months prior to delivery. Lot size shall not exceed the maximum testing frequencies, which shall not exceed 5000 blocks for dry-cast blocks and the lesser of 150 CY or 1 day's production for wet-cast blocks. Test results will represent all blocks within the lot. Each pallet of blocks delivered shall bear lot identification information. Block lots that do not meet the requirements of this specification or blocks without supporting reports will be rejected and shall be removed from the project at no expense to the City of Madison.

Nonconforming materials will be subject to evaluation according to standard spec 106.5.

B.3.2 Leveling Pad

Provide an unreinforced cast-in-place concrete or base aggregate leveling pad. Use Grade A, A-FA, A-S, A-T, A-IS, A-IP, or A-IT concrete conforming to standard spec 501 as modified in standard spec 716. Provide QMP for leveling pad concrete as specified in standard spec 716, Class III Concrete. Use Base Aggregate Dense 1 1/4-Inch conforming to standard spec 305.

The minimum width of the concrete leveling pad shall be as wide as the proposed blocks plus 6-inches, with 6-inches of the leveling pad extending beyond the front face of the blocks. The minimum thickness of the leveling pad shall be 6-inches.

The minimum width of the base aggregate leveling pad shall be as wide as the proposed blocks plus 12-inches, and the modular blocks centered on the leveling pad. The minimum thickness of the leveling pad shall be 12-inches after compaction.

B.3.3 Backfill

Furnish and place backfill for the wall as shown on the plans and as hereinafter provided.

Wall Backfill, Type A, shall comply with the requirements for Coarse Aggregate Size No. 1 as given in standard spec 501.2.5.4. All backfill placed within a zone from the top of the leveling pad to the top of the final layer of wall facing units and within 1 foot behind the back face of the wall shall be Wall Backfill, Type A, including all material used to fill openings in the wall facing units.

A layer of Geotextile Type “DF” (Schedule B) shall be placed vertically between the backfill and the Type A backfill. The geotextile shall extend from the top of the leveling pad to 6 inches below the surface of the retained soil. The geotextile shall then wrap across the top of the Type A backfill to the back of block wall facing.

Backfill placed between retained soil and Type A backfill shall comply with the requirements for Granular Backfill Grade 1 as contained in 209.2.2 of the standard spec. The contractor may substitute Type A Backfill for Granular Backfill Grade 1.

C Construction

C.1 Excavation and Backfill

Excavation and preparation of the foundation for the wall and the leveling pad shall be according to standard spec 206. At the end of each working day, provide good temporary drainage such that the backfill shall not become contaminated with run-off soil or water if it should rain. Do not stockpile or store materials or large equipment within 10 feet of the back of the wall.

Place backfill materials in the areas as indicated on the plans and as detailed in this specification. Backfill lifts shall be no more than 8-inches in depth, after compaction. Backfilling shall closely follow erection of each course of wall facing units.

Conduct backfilling operations in such a manner as to prevent damage or misalignment of the wall facing units or other wall components. At no expense to the City of Madison, correct any such damage or misalignment as directed by the engineer. A field representative of the wall supplier shall be available during wall construction to provide technical assistance to the contractor and the engineer.

Do not operate tracked or wheeled equipment on the backfill within 3 feet from the back face of modular blocks. The engineer may order the removal of any large or heavy equipment that may cause damage or misalignment of the wall facing units.

C.2 Compaction

Compact wall backfill Type A with at least three passes of lightweight manually operated compaction equipment acceptable to the engineer.

Ensure adequate moisture is present in the backfill during placement and compaction to prevent segregation and to help achieve compaction.

Compaction of backfill within 3 feet of the back face of the wall shall be accomplished using lightweight compaction devices. Use of heavy compaction equipment or vehicles shall be avoided within 3 feet of the modular blocks.

C.3 Wall Components

C.3.1 General

Erect wall facing units and other associated elements according to the wall manufacturer’s construction guide and to the lines, elevations, batter, and tolerances as shown on the plans. Center the initial layer of facing units on the leveling pad; then level them and properly align them. Fill formed voids or openings in the facing units with wall backfill, Type A. Remove all debris on the top of each layer of facing units, before placing the next layer of facing units.

Install all pins, rods, clips, or other devices used to develop mechanical interlock between facing unit layers according to the manufacturer’s directions.

C.3.2 Leveling Pad

Provide an unreinforced cast-in-place concrete or base aggregate leveling pad as shown on the plans. Vertical tolerances shall not exceed 3/4-inch when measured along a 10-foot straight edge. Allow the concrete to set at least 12 hours prior to placing wall facing units.

The bottom row of wall facing units shall be horizontal and 100% of the unit surface shall bear on the leveling pad.

C.4 Geotechnical Information

Geotechnical data to be used in the design of the wall is given on the wall plan.

D Measurement

The City of Madison will measure Wall Modular Block Gravity Landscape (Location) by the square foot acceptably completed. The City of Madison will compute the measured quantity from the theoretical pay limits the contract plans show. The City of Madison will make no allowance for wall area constructed above or below the theoretical pay limits. All work beyond the theoretical pay limits is incidental to the cost of work. The City of Madison will make no allowance for as-built quantities.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0165.402	Wall Modular Block Gravity Landscape (Portage)	SF
SPV.0165.403	Wall Modular Block Gravity Landscape (Independence)	SF

Payment is full compensation for supplying a design and shop drawings; preparing the site, including all necessary excavation and disposal of materials; supplying all necessary wall components to produce a functional wall system including cap, copings, leveling pad, and leveling pad steps; constructing the retaining system and providing temporary drainage; providing backfill, backfilling, compacting, developing/completing/documenting the quality management program, and performing compaction testing.

The City of Madison will pay separately for railings, and other items above the wall cap or coping.

(20210121)

13. Drainage, Sewer, & Erosion Control.

13-1 General.

Inspect existing storm, sanitary, and combined infrastructure prior to connecting to existing infrastructure. Work with the engineer in cases where substandard infrastructure could adversely impact the system. Payment shall be adjusted if the engineer agrees that manholes or catch basins need to be reconstructed rather than adjusted. Unit prices for reconstructing manholes and catch basins provided by the contractor at the time of bidding is to be used if reconstruction is agreed upon by the contractor and the engineer.

13-2 Erosion Control.

Add the following to standard spec 107.20:

Provide the Erosion Control Implementation Plan (ECIP) a minimum of fourteen days prior to the pre-construction meeting. Pursue operations in a timely and diligent manner, continuing all construction operations methodically from the initial removals and topsoil stripping operations through the subsequent grading, paving, and re-topsoiling to minimize the period of exposure to possible erosion.

Topsoil graded areas, as designated by the engineer, immediately after grading has been completed within those areas. Seeding shall be completed and erosion mat installed on all topsoiled areas within 5 working days after placement of topsoil.

Contractor shall provide an open aggregate concrete truck washout area on site. Contractor to ensure that concrete washout shall be contained to this designated area and not be allowed to run into storm inlets or into the overland storm water drainage system. Washout area shall be removed upon completion of construction.

13-3 Salvaging Castings.

The contractor shall comply with section 203.2 of the City of Madison standard specifications with regard to salvaging castings.

13-4 Removing Storm Sewer.

Revise standard spec 204.3.2.2.1 (13):

Under the Removing Storm Sewer bid items, remove existing storm sewer, sanitary sewer or combined sewer as called out in the plans. Backfill resulting trenches with granular backfill conforming to subsection 209.2 of the standard specifications.

13-5 Abandoning Sewer, Item 204.0291.S.

A Description

This special provision describes abandoning existing sewer by filling it with cellular concrete as the plans show and conforming to standard spec 204 and standard spec 501 as modified in this special provision.

B Materials

Provide cellular concrete meeting the following specifications: 1 part cement, 1 part fly ash, 8 parts sand, or an approved equal, and water. Provide cement meeting the requirements of standard spec 501.2.4.1 for Type 1 Portland Cement. Provide sand meeting the requirements of standard spec 501.2.7.2. Provide water meeting the requirements of standard spec 501.2.6.

C Construction

Fill the abandoned sewer pipe with cellular concrete as the engineer directs. If the sewer cannot be completely filled from existing manholes, tap the sewer where necessary and fill from these locations.

D Measurement

City of Madison will measure Abandoning Sewer in volume by the cubic yard as specified in standard spec 109.1.3.

E Payment

City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
204.0291.S	Abandoning Sewer	CY

Payment is full compensation for furnishing all materials and excavating and backfilling where necessary.

stp-204-050 (20210708)

13-6 Inlet Covers Type H

Add the following to standard spec 611.2(4):

Use City approved casting products for structures specified in this plan. Refer to City of Madison standard specification section 507.2 for approved casting products.

13-7 Engineered Soil, Item SPV.0035.601.

A Description

This special provision describes the installation of Engineered Soil at locations as indicated on the plans.

B Materials

The soil shall be engineered to the following specifications as detailed in the WDNR Standard:

The engineered soil shall be, by volume: 85% sand and 15% compost, and must be well mixed prior to placement.

1. The sand component shall be meet the requirements of the WDNR Standard:
    a. It shall be pre-washed to remove clay and silt particles, and dried prior to mixing. Calcium carbonated, dolomitic, or manufactured sand, and other substitutions are not allowed.
    b. It shall meet one of the following gradation requirements:

i. USDA Coarse Sand (0.02 – 0.04 inches).

ii. ASTM C33 (Fine Aggregate Concrete Sand).

iii. State Specifications Section 501.2.5.3.4.

2. The compost component shall meet the following specifications as detailed in the WDNR Compost Specification S100:

   a. Particle Size - 95% of the compost shall pass through a.1/2 inch screen.

   b. Physical Contaminants - Less than 1% combined glass, metal and plastic.

   c. Organic Matter/Ash Content - Compost shall have at least 40% organic matter and less than 60% ash content.

   d. Carbon to Nitrogen Ratio - The ratio shall be 10-20:1 C:N ratio.

   e. pH - The pH of the compost shall be between 6 and 8.

   f. Soluble salts – Electrical conductivity shall be below 10 dS m-1 (mMhos cm-1).

   g. Moisture Content - The compost shall have moisture content between 35% and 50% by weight.

   h. Maturity - The compost shall be resistant to further decomposition and free of compounds, such as ammonia and organic acids, in concentrations toxic to plant growth. (A Solvita Method Compost Maturity Index of 6-8 would be an indicator of mature compost. A seedling germination test of 88% or higher would be another indicator of mature compost.)

   i. Residual Seeds & Pathogens - Pathogens and noxious seeds shall be minimized. (This may be achieved through a composting method that maintains a minimum critical temperature (55 degrees Celsius) for at least 3 consecutive days for compost piles and for at least 15 consecutive days for turned windrow systems.)

   j. Other Chemical Contaminants - Concentrations of heavy metals such as arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc should be negligible and shall be in compliance with US EPA 503 regulations for Class A biosolids.

The engineered soil mix shall be free of rocks, stumps, roots, brush, or other material over 1 inch in diameter. No other materials shall be mixed with the planting soil that may be harmful to plant growth or prove a hindrance to planting or maintenance.

The engineered soil mix shall have a pH between 5.5 and 8.0.

The engineered soil mix shall have adequate nutrient content to meet plant growth requirements.

C Construction

C.1 Common Excavation and Grading

1. Compaction and smearing of the soils beneath the floor and side slopes of the engineered soil area, and compaction of the soils used for backfill in the soil planting bed, shall be minimized.

2. If compaction occurs at the base of the bioretention device, the soil shall be refractured to a depth of at least 12 inches. If smearing occurs, the smeared areas of the interface shall be corrected by raking or roto-tilling.

1. Excavated areas shall be free of roots.

2. Excess Material:

   a. City of Madison has first right to excess grading material suitable for backfilling or site grading, not required at the job site.

   b. Excess excavated material not required or not suitable for top soil and other waste material shall be disposed of in accordance with local regulatory requirements.

3. Grade to 6 inches below finished grade in areas to receive topsoil, unless new grade is less than 6 in. above existing grade. Maximum allowable variation from design elevation is 1 in. in 10 ft. Degree of finish shall be ordinarily obtainable from either blade-grader or scraper operations, except as otherwise specified.

4. Placement Location

   a. Engineered soil to be used at depths and locations described in the plans.

C.2 Placement of Engineered Soil

1. Prior to placement, the engineered soil shall be pre-mixed and the moisture content shall be low enough to prevent clumping and compaction during placement.
2. Notify engineer 24 hours before placing engineered soil.
3. The engineered soil shall be placed in multiple lifts, each approximately 6 inches.
4. Steps may be taken to induce mild settling of the engineered soil bed as needed to prepare a stable planting medium and to stabilize the ponding depth. The steps can include light use of a hand tamper between lifts. Vibrating plate style compactors shall not be used to induce settling.
5. If the final top surface of the engineered soil is compacted, mitigation measures such as roto-tilling or raking shall be taken.

C.3 Construction Sequencing

1. Excavation for drainage infrastructure within the area identified for requiring engineered soil shall be completed prior to the construction of the engineered soil area.
2. Construction site runoff from disturbed areas shall not be allowed to enter the engineered soil area device. Runoff from pervious areas shall be diverted from the device until the pervious areas have undergone final stabilization. Sloped areas shall be stabilized before the engineered soil area engineered soil, topsoil, and seedings are installed.
3. Actual weather conditions may require modification to schedule. Construction shall be suspended during periods of rainfall or snowmelt. Construction shall remain suspended if ponded water is present or if residual soil moisture contributes significantly to the potential for soil smearing, clumping or other forms of compaction. Contractor shall coordinate with the engineer on acceptable schedule modifications.

D Measurement

The City of Madison will measure Engineered Soil per cubic yard (CY) in place.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0035.601	Engineered Soil	CY

Payment includes all equipment, labor and materials necessary to complete this item as specified.

13-8 Storm Water Wet Pond Clay Liner, Item SPV.0035.602.

A Description

This special provision describes the installation of Storm Water Wet Pond Clay Liner at locations as indicated on the plans.

B Materials

Conform to requirements of WDNR Standard 1001 Type B.

C Construction

C.1 Examination

A. Examine surfaces to receive fill to determine existence of areas loosened by frost action, softened by flooding or weather or of unsuitable materials.

B. Immediately notify Owner if unexpected subsurface facilities or suspected hazardous materials are encountered during excavation. Discontinue affected work in area until notified to resume work.

C.2 Preparation

A. Fill settled areas where excavations or trenches were backfilled and holes made by demolition, tree removal, and site preparation work.

B. Natural soils or compacted fill softened by frost, flooding or weather shall be removed, replaced, and compacted.

C. Remove unsuitable material from under walks, parking, and driveway areas.

D. Proof roll areas to receive fill material with drum or rubber tire roller having gross load between 25 to 50 tons to detect soft or loose zones prior to placing fill. Remove and replace soft or loose zones.

E. Keep construction site free-draining.

F. Plow, step, or bench slopes steeper than 1 vertical to 4 horizontal.

G. Disc level surfaces.

C.3 Excavation

A. Pond: Over excavate pond to grades shown on plan to allow for placement of Clay Liners. Reuse excavated material for pond grading embankments.

B. Establish limits of excavation to allow adequate working space for other operations by Owner and Owner's Contractors for safety of personnel.

C. Carry out excavation, dewatering and excavation support systems to eliminate possibility of undermining or disturbing existing structures and pavements.

C.4 Fill Usage

A. Clay: Placed as shown on plans.
1. Average Plasticity Index (PI) of 7 or more with no value less than 5.
2. Average Liquid Limit (LL) of 16 or greater, with no value less than 14.
3. 50% of the soil by weight passing the #200 sieve.

C.5 Placing Fill

A. Notify engineer before placing fill material.
B. Do not use frozen material or place fill on frozen subgrade.
C. Provide mechanical compaction for cohesive materials.
D. Lift Thickness and Compaction: Place and compact clay liner materials in 6-in. maximum loose lift thickness. Compact liner to 95% maximum dry density as determined by ASTM D-698 (standard proctor).
E. Native clay to be compacted in accordance with National Resources Conservation Service (NRCS) Wisconsin Construction Specification 300, Clay Liners, using a sheepsfoot (or similar type) compactor weighing at least 25,000 lbs., operated continuously, in maximum 6-inch loose lifts
F. Conform to requirements of WDNR Standard 1001 Type B.

C.6 Field Quality Control

A. Testing:

1. 18 (total) field density tests of clay liner in place. One test per 40-foot grid per 1 foot thickness of clay liner (9 tests).
2. Two in place hydraulic conductivity tests per ASTM D5084. (1×10^{-6} cm./sec or less)

B. Degree of Compaction: 95% ASTM D-698 (Standard Proctor)

C. Moisture Content of Clay Liner: At least 2% wet of optimum.

C.7 Adjustment and Cleaning

A. Excess Material:

1. Remove excess material from site.

B. Rough grade areas within grading lines and areas which are disturbed to achieve lines and grades indicated on Drawings, with allowance for thickness of pavements, sidewalks, and topsoil.

D Measurement

The City of Madison will measure Storm Water Wet Pond Clay Liner per cubic yard (CY) in place.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0035.602	Storm Water Wet Pond Clay Liner	CY

Payment includes all equipment, labor and materials necessary to complete this item as specified.

13-9 Saddled Inlet Type I, Item SPV.0060.601.

A Description

This special provision describes the installation of saddled Inlets Type I at locations as indicated on the plans. The casting is not included in this item.

B Materials

Follow City of Madison standard detail drawing 5.7.8 and Article 507 of the City of Madison standard specifications.

C Construction

Follow City of Madison standard detail drawing 5.7.8 and Article 507 of the City of Madison standard specifications.

D Measurement

The City of Madison will measure Saddled Inlet Type I as each individual saddled inlet Type I as provided on the plans, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.601	Saddled Inlet Type I	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified. The casting will be paid for separately.

13-10 Inlets 2x3-FT, Special, Item SPV.0060.602.

A Description

This special provision describes providing Inlets 2x3-FT, Special as the plans show. Conform to standard spec 611 and this special provision.

B Materials

Materials shall be conforming to standard spec 611.2. The adjusting ring shall be Cretex Pro-Ring or approved equal.

Use manufacturer approved adhesive/sealant. Supply manufacture’s recommendations prior to installation.

C Construction

Construction shall be conforming to the plans and with standard spec 611.3.

Replace standard spec 611.3.3(1) with the following:

Set inlet cover on Pro-Ring adjustment riser ring. Use adhesive/sealant between the ring and the inlet structure. Use adhesive/sealant between the ring and the inlet cover. Use two 5/16-inch beads of adhesive placed 1 inch and 2 inches in from the outside edge of the ring. If multiple adjustment rings are necessary, a maximum of two adjustment rings can be used. A maximum of 3 inch adjustment is allowed. Use manufacturer approved adhesive/sealant to join the two rings. If the adjustment rings must be cut, the joints must be staggered, and a polyurethane adhesive used to reattach the cut ends. No concrete adjustment rings or mortar is to be placed between the top of the structure and the inlet cover.

Use sloped adjusting rings to match the slope of the frame to the cross slope of the pavement. The slope shall not be less than the cross slope of the of the pavement. See plan sheets for pavement slope.

D Measurement

The City of Madison will measure Inlets 2x3-FT, Special as each individual inlet acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.602	Inlets 2x3-FT, Special	EACH

Payment shall be conforming to standard spec 611.5.

13-11 Field Pour Storm Structure, Item SPV.0060.603.

A Description

This special provision describes the installation of Type H Inlet at locations as indicated on the plans.

B Materials

Follow City of Madison standard detail drawing 5.7.3 and 5.7.3A.

C Construction

Follow City of Madison standard detail drawing 5.7.3 and 5.7.3A.

D Measurement

The City of Madison will measure Field Pour Storm Structure as each individual Field Pour Storm Structure, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.603	Field Pour Storm Structure	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

13-12 Storm Cleanout, Item SPV.0060.604.

A Description

This special provision describes the installation of Storm Cleanout at locations as indicated on the plans.

B Materials

The 6” dia. Storm cleanouts shall be non-perforated SDR 35 PVC with wye, long sweep 45 degree wye bend, 6” dia. PVC pipe and 6” dia. screw in plug set at 4 inches below finished grade. A ductile iron frost sleeve with flush mounted screw in lid shall be provided around the 6” dia. PVC to a depth 6 inches above the storm underdrain.

C Construction

Follow section 608 of the standard specifications.

D Measurement

The City of Madison will measure Storm Cleanout as each individual Storm Cleanout as provided on the plans, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.604	Storm Cleanout	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

13-13 Storm Sewer Tap, Item SPV.0060.606.

A Description

This special provision describes tapping various sized storm sewer pipes into existing structures, including manholes or inlets, or other pipes at locations shown on the plans. Perform the work in accordance to the applicable provisions of standard spec 607 and standard spec 611, and as hereinafter provided.

B (Vacant)

C Construction

Tap into the existing structure to allow the pipe to be flush with the interior wall of the existing pipe or structure. All necessary temporary shoring needed for construction of this item will not be paid for separately but will be included in this item of work.

D Measurement

The City of Madison will measure Storm Sewer Tap by each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.606	Storm Sewer Tap	EACH

Payment is full compensation for providing all materials, including saw cuts, for excavating; for removing concrete; for providing and removing sheeting and shoring, making connections to new or existing facilities, and for cleaning out.

13-14 Inlet Covers Type R-1879-B4G, Item SPV.0060.608.

A Description

This special provision describes furnishing and installing inlet covers in accordance with the applicable provisions of standard spec 611 and as indicated on the plans.

B Materials

Neenah R-1879-B4G Frame and Lid.

C (Vacant)

D Measurement

The City of Madison will measure Inlet Covers Type R-1879-B4G by each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.608	Inlet Covers Type R-1879-B4G	EACH

Payment is full compensation for providing new covers, including frames, grates or lids, all other required materials, for installing and adjusting each cover, and incidentals necessary to complete the contract work.

13-15 Inlet Covers Type R-1878-B7G, Item SPV.0060.611

A Description

Perform work in accordance with the applicable provisions of standard spec 611 and as indicated on the plans.

B Materials

Neenah R-1878-B7G Frame and Lid

C (Vacant)

D Measurement

The City of Madison will measure Inlet Covers Type R-1878-B7G by each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.611	Inlet Covers Type R-1878-B7G	EACH

Payment is full compensation for providing new covers, including frames, grates or lids, all other required materials, for installing and adjusting each cover, and incidentals necessary to complete the contract work.

13-16 Connect Pipe Underdrain to Existing Structure, Item SPV.0060.614.

A Description

This special provision describes coring a hole into an existing storm sewer structure to connect proposed pipe underdrain. Perform the work in accordance to the applicable provisions of standard specs 608, 611, and 612, and as shown on the plans.

B Materials

Furnish mortar conforming to standard spec 519.2.3.

C Construction

Core into the existing storm sewer structure. Insert the pipe underdrain to be flush with the interior of the existing structure. Construct watertight connection between the pipe underdrain and existing storm sewer structure using Portland cement mortar.

D Measurement

The City of Madison will measure Connect Pipe Underdrain to Existing Structure as each individual connect pipe underdrain to existing structure acceptably completed.

E Payment

City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.614	Connect Pipe Underdrain to Existing Structure	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

13-17 Sewer Cleanout, Item SPV.0060.621; Lateral Cleanout, Item SPV.0060.628.

A Description

This special provision describes the installation of sewer cleanouts at locations shown in the drawings, according to the construction details, or City of Madison standard detail drawing 5.7.41.

B Materials

Follow City of Madison Standard Specification Part V.

C Construction

Follow City of Madison Standard Specification Part V.

D Measurement

The City of Madison will measure Sewer Cleanout as each individual Sewer Cleanout, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.621	Sewer Cleanout	EACH
SPV.0060.628	Lateral Cleanout	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified. Payment includes the connection from the existing pipe to the proposed pipe. Payment includes costs of all fittings, connections, castings, and all other items shown in the storm sewer cleanout detail and the City of Madison lateral cleanout detail.

13-18 Adjust Inlets 2x3-FT, Special, Item SPV.0060.624.

A Description

This special provision describes adjusting inlets as the plans show. Conform to standard spec 611 and as follows.

B Materials

Materials shall be conforming to standard spec 611.2 and 611.3. The adjusting ring shall be Cretex Pro-Ring or approved equal.

Use manufacturer approved adhesive/sealant. Supply manufacture's recommendations prior to installation.

C Construction

Construction shall be conforming to the plans and with standard spec 611.3.7.

Replace standard spec 611.3.7(1) with the following:

Unless the contract plans or special provisions provide otherwise, adjust existing covers, including frames and grates or lids, to the required elevation. Remove the existing fixture, adjust the top of the existing structure, and reinstall the fixture. Support the fixture on a collar of concrete, brick masonry, concrete brick or block masonry, constructed to hold the covers firmly in place. A Cortex Pro-Ring adjusting ring shall be used

Use sloped adjusting rings to match the slope of the frame to the cross slope of the pavement. The slope shall not be less than the cross slope of the of the pavement. See plan sheets for pavement slope.

D Measurement

The City of Madison will measure Adjusting Inlets 2x3-FT, Special as each individual inlet acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.624	Adjusting Inlets 2x3-FT, Special	EACH

Payment shall be conforming to standard spec 611.5.

13-19 Inlet Casting Offset, Item SPV.0060.625.

A Description

This special provision describes the inlet casting offset at locations as indicated on the plans.

B Materials

Follow City of Madison standard detail drawing 5.7.29.

C Construction

Follow City of Madison standard detail drawing 5.7.29.

D Measurement

The City of Madison will measure Inlet Casting Offset as each individual Inlet Casting Offset Structure, acceptably completed.

E Payment

City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.625	Inlet Casting Offset Structure	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

13-20 Sidewalk Trench Drain, Item SPV.0090.601.

A Description

This special provision describes the installation of Sidewalk Trench Drain at locations as indicated on the plans.

B Materials

Follow City of Madison standard detail drawing 5.7.36.

C Construction

Follow City of Madison standard detail drawing 5.7.36.

D Measurement

The City of Madison will measure Sidewalk Trench Drain as linear feet of Sidewalk Trench Drain, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.601	Sidewalk Trench Drain	LF

Payment includes all equipment, labor and materials necessary to complete this item as specified.

14. Signing and Marking.

14-1 General.

Prior to placement of permanent signing and pavement markings, coordinate with the City of Madison.

Contact Madison Metro Transit a minimum of 1 week prior to arrange for bus stop sign pickup. The contact is Katie Sellner (608) 261-9633 or ksellner@cityofmadison.com.

A future project is anticipated on Mineral Point Road that includes sidewalk modifications, new curb ramp construction, and curb ramp reconstructions within these project limits. The signing and pavement marking plans assume the future project will occur after this project.

14-2 Lane Drop Arrow, Item SPV.0060.101.

A Description

This special provision describes providing pavement marking arrows.

B Materials

Furnish pavement marking products in compliance with standard spec 646.2 and as shown in the plans.

C Construction

Prepare the surface and apply markings in compliance with standard spec 646.3 and as shown in the plans.

D Measurement

The City of Madison will measure Lane Drop Arrow by each, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.101	Lane Drop Arrow	EACH

Payment is full compensation for all materials, labor and incidentals for providing the marking, in accordance with the drawings and as set forth in these specifications.

14-3 Pavement Marking Epoxy, Continental Crosswalk, 18-Inch, Item SPV.0090.101.

A Description

This special provision describes providing pavement markings at crosswalks.

B Materials

Furnish pavement marking products in compliance with standard spec 646.2 and as shown in the plans.

C Construction

Prepare the surface and apply markings in compliance with standard spec 646.3 and as shown in the plans.

D Measurement

The City of Madison will measure Continental Crosswalks by the linear foot, perpendicular to the crosswalk bars, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.101	Pavement Marking Epoxy, Continental Crosswalks, 18-Inch	LF

Payment is full compensation for all materials, labor and incidentals for providing the marking, in accordance with the drawings and as set forth in these specifications.

14-4 Pavement Marking Epoxy, Stop Line, 24-inch, Item SPV.0090.102, Pavement Marking Epoxy, Line 6-Inch, Item SPV.0090.103, Pavement Marking Epoxy, Line, 8-Inch, Item SPV.0090.104, Pavement Marking Epoxy, Diagonal Line, 4-Inch, Item SPV.0090.105, Pavement Marking Epoxy, Diagonal Line, 8-Inch, Item SPV.0090.106, Pavement Marking Epoxy, Radius Line, 5-Inch, Item SPV.0090.107.

A Description

This special provision describes providing epoxy pavement markings.

B Materials

Furnish pavement marking products in compliance with standard spec 646.2 and as shown in the plans.

C Construction

Prepare the surface and apply markings in compliance with standard spec 646.3 and as shown in the plans.

D Measurement

The City of Madison will measure these items by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.102	Pavement Marking Epoxy, Stop Line, 24-inch	LF
SPV.0090.103	Pavement Marking Epoxy, Line 6-Inch	LF
SPV.0090.104	Pavement Marking Epoxy, Line 8-Inch	LF
SPV.0090.105	Pavement Marking Epoxy, Diagonal Line, 4-Inch	LF
SPV.0090.106	Pavement Marking Epoxy, Diagonal Line, 8-Inch	LF
SPV.0090.107	Pavement Marking Epoxy, Radius Line, 5-Inch	LF

Payment is full compensation for all materials, labor and incidentals for providing the marking, in accordance with the drawings and as set forth in these specifications.

14-5 Skid/Slip Resistant Preformed Thermoplastic Pavement Marking, 6-Inch White Retroreflective Line, Item SPV.0090.108.

A Description

This special provision describes furnishing and installing a durable, high skid and slip resistant 6-inch white retroreflective preformed thermoplastic linear pavement marking for use on asphalt or Portland cement concrete pavement surfaces.

B Materials

B.1 General

Preformed thermoplastic pavement marking to be produced of the materials and by methods described below as manufactured by Ennis-Flint or approved equal.

The marking material must be produced in the United States, and the manufacturer must be ISO 9001:2008 certified for design, development and manufacturing of preformed thermoplastic pavement markings, and provide proof of current certification.

The material shall be capable of being applied on bituminous and/or Portland cement concrete pavements by the use of a handheld heat torch, and/or infrared heater without preheating the surface.

The material shall be capable of being applied in temperatures down to 45ºF (7.2ºC) without any special storage, preheating or treatment of the material before application.

The material must be a resilient light green color preformed thermoplastic product which contains a minimum of thirty percent (30%) intermixed anti-skid/anti-slip elements with a hardness range of 7-9 (Mohs scale), and where the top surface contains anti-skid/anti-slip elements with a hardness of 9 (Mohs scale).

Material shall be composed of an ester-modified rosin impervious to degradation by motor fuels, lubricants, etc., in conjunction with aggregates, pigments, binders, and anti-skid/anti-slip elements uniformly distributed throughout the material. The thermoplastic material shall conform to AASHTO designation M249, with the exception of the relevant differences due to the material being supplied in a preformed state, being non-reflective, and being of a color different from white or yellow.

B.2 Pigment Color

The bike lane green color shall be manufactured with appropriate pigment to ensure that the resulting colors complies with the Light Green color as specified in the FHWA Memorandum dated April 15th, 2011: Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14).

The pigment system must not contain heavy metals or any carcinogen, as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

B.3 Heating Indicators

The top surface of the material shall have regularly spaced indents. The closing of these indents during application shall act as a visual cue that the material has reached a molten state, allowing for satisfactory adhesion and proper embedment of the anti-skid/anti-slip elements, and a post-application visual cue that proper application procedures have been followed.

B.4 Skid Resistance

The surface of the preformed thermoplastic material shall contain factory applied anti-skid elements with a minimum hardness of 9 (Mohs scale). Upon application, the material shall provide a minimum skid resistance value of 60 BPN when tested according to ASTM E 303.

B.5 Slip Resistance

The surface of the preformed thermoplastic material shall contain factory applied anti-skid elements with a minimum hardness of 9 (Mohs scale). Upon application the material shall provide a minimum static coefficient of friction of 0.6 when tested according to ASTM C 1028 (wet and dry), and a minimum static coefficient of friction of 0.6 when tested according to ASTM D 2047.

B.6 Thickness

The material must be supplied at a minimum thickness of 90 mils (2.29 mm) or 125 mils (3.15 mm).

B.7 Environmental Resistance

The material shall be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

C Construction

C.1 Construction Method

Install 6-inch preformed thermoplastic white retroreflective line in accordance with manufacture’s specifications.

C.2 Performance Requirements

Preformed thermoplastic white retroreflective lines shall be installed per plans and specification. The engineer will notify the contractor within 48 hours of installation regarding any lines that are not installed to specification or to the satisfaction of the engineer. Non-conforming lines shall be removed at no charge to the City and replaced with a conforming product.

D Measurement

The City of Madison will measure per linear foot (LF) of 6-inch preformed thermoplastic white retroreflective line installed and accepted.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV. 0090.108	Skid/Slip Resistant Preformed Thermoplastic Pavement Marking, 6-Inch White Retroreflective Line	LF

Payment is full compensation for all work, materials, labor, and incidentals required to complete the work as specified, including any re-application or repair required under the performance requirements as provided herein.

14-6 Marking Removal Longitudinal Line, 8-Inch Wide Max, Item SPV.0090.109, Marking Removal Wide Line Greater Than 8-Inch, Item SPV.0090.110, Marking Removals Ladder/Continental Crosswalks, Item SPV.0090.111, Marking Removal Special – Arrows, Words and Symbols, Item SPV.0060.102.

A Description

This special provision describes removing pavement markings.

B Materials

Remove pavement marking in compliance with standard spec 646.3 and as shown in the plans.

C Construction

Prepare the surface and apply markings in compliance with standard spec 646.3 and as shown in the plans.

D Measurement

The City of Madison will measure the Marking Removal Longitudinal Line, 8-Inch Wide Max by the linear foot of material removed, Marking Removal Wide Line Greater Than 8-Inch by the linear foot of material removed, Marking Removals Ladder/Continental Crosswalks by the linear foot of material removed, and Marking Removal Special by each removed, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.109	Marking Removal Longitudinal Line, 8-Inch Wide Max	LF
SPV.0090.110	Marking Removal Wide Line Greater Than 8-Inch	LF
SPV.0090.111	Marking Removals Ladder/Continental Crosswalks	LF
SPV.0060.102	Marking Removal Special – Arrows, Words and Symbols	EACH

Payment is full compensation for removing the marking and for resealing areas of clear protective surface treatments.

14-7 Marking Line Special Epoxy 8-Inch, Item SPV.0090.112.

A Description

This special provision describes providing epoxy pavement marking.

B Materials

Furnish pavement marking products in compliance with standard spec 646.2 and as shown in the plans.

C Construction

Prepare the surface and apply markings in compliance with standard spec 646.3 and as shown in the plans.

D Measurement

The City of Madison will measure these items by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.112	Marking Line Special Epoxy 8-Inch	LF

Payment is full compensation for all materials, labor and incidentals for providing the marking, in accordance with the drawings and as set forth in these specifications.

14-8 Methyl Methacrylate Red, Item SPV.0165.101.

A Description

This special provision describes providing Methyl Methacrylate Red pavement markings.

B Materials

The Methyl Methacrylate (MMA) Acrylic Resin Material System shall include primer, material, top coat, and all other system materials in compliance with the manufacturer's specifications and application instructions.

B.1 General

Anti-slip treated MMA pavement marking to be produced of the materials and by methods described below.

The material must be produced in the United States, and the manufacturer must be ISO 9001:2008 certified for design, development and manufacturing of colored pavement materials, and provide proof of current certification.

The material shall be capable of being applied on bituminous and/or Portland cement concrete pavements and must be able to be applied after 30 days of placement.

The material must be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. It shall not be necessary to use a grid template or to make pattern grooves or other indentations in the asphalt or concrete surface prior to applying the material. It shall not be necessary to inlay the material in grooves or indentations. It shall not be necessary to heat the pavement or application surface to a specific temperature.

The material shall be capable of being applied in temperatures down to 40ºF without any special storage, preheating or treatment of the material before application.

Material shall be resistant to the detrimental effects of motor fuels, antifreeze, lubricants, hydraulic fluids composed of an ester modified resin impervious to degradation by motor fuels, lubricants, etc. in conjunction with aggregates, pigments, binders, and anti-skid/anti-slip elements.

Material is not required to be retroreflective.

Pigments and anti-skid/anti-slip elements must be uniformly distributed throughout the material.

Elongation of material resin shall have a minimum of 30% when tested in accordance with ASTM D638 Type I.

Water Absorption shall be a maximum of 0.25% when tested in accordance with ASTM D570.

Solids Content shall be a minimum of 99% when tested in accordance with ASTM D1644.

B.2 Pigment Color

The transit red color shall be manufactured with appropriate pigment to ensure that the resulting colors complies with red color as specified in the FHWA Memorandum dated December 4th, 2019: Interim Approval for Optional Use of Red-Colored Pavement for Transit Lanes (IA-22).

The pigment system must not contain heavy metals nor any carcinogen, as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

B.3 Skid Resistance

The aggregate used in the Methyl-Methacrylate coating shall have a minimum hardness of 8.5 (Mohs scale). Upon application the material shall provide a minimum skid resistance value of 60 BPN when tested according to ASTM E 303 or minimum value of 40 when tested according to ASTM E 274.

The aggregate shall be determined with options of #0, #1 or #2 kiln dried silica sand, corundum or bauxite dependent on use of pavement marking and ADT.

B.4 Hardness

The material must meet a minimum hardness value of 55-60 per ASTM D2240.

B.5 Thickness

The material must be supplied at a minimum thickness of 80 mils.

B.6 Environmental Resistance

The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

B.7 Performance Measures of Durability

Minimum Durability – 90 percent of each colored area, legend, or symbol must be present.

Failure to meet any of the specified performance measures on at least 90 percent of the colored area is considered a failure. engineer may require partial or complete replacement of the colored area under the warranty terms.

Failure to meet any of the specified performance measures on at least 90 percent of the legend or symbol is considered a complete failure of that legend or symbol. Replace under the warranty terms.

B.8 Submittals

Submit:

a. Product Data describing physical and performance characteristics and colors available

b. Material Certification: Provide a Manufacturer's written certification that the material complies with these specifications.

c. Samples: Submit manufacturer's sample of materials, finishes, and colors

d. Quality Control Plan

- Description of equipment for placing MMA
- Description of equipment for measuring, mixing, placing, and finishing MMA
- Method for protecting areas not to receive MMA
- Cure time estimates for MMA
- Storage and handling of MMA components
- Disposal of excess MMA and containers
- Contingency plan for possible failure during the MMA application including remediation

C Construction

All pavement marking areas shall be laid out by the contractor and then reviewed by the engineer. Obtain approval of the marking layout from the engineer prior to placement of material.

Prepare the surface and apply markings in compliance with manufacturer's specifications and application instructions and as shown in the plans. Surface preparation shall include cleaning and preparation of the pavement surface using high pressure water, compressed air, sand-blasting or shot-blasting. Prepare asphalt and concrete surfaces per material manufacturer recommendations and obtain approval from the engineer prior to applying markings. Concrete surfaces shall require shot blasting preparation in addition to any other methods of preparation used. All surface damage shall be corrected by the contractor at the contractor's expense, as directed by the engineer. Manufacturer recommended pavement and air temperatures must be followed.

Manufacturer's instructions include age harden or cure requirements for new pavements prior to application. New Hot Mix Asphalt shall have been placed 15-30 days prior to installation of the MMA acrylic colorized material and surface oils shall not be present. MMA acrylic colorized material applied on concrete surfaces shall receive a base coat application and shall be included in the pay item. Marking layout, material mixing, base coat application, and pigmented coat application shall comply with the manufacturer's installation procedures.

Protect the pavement markings from damage and allow them to fully cure prior to allowing traffic to drive over markings. Any damage shall be corrected by the contractor at the contractor's expense.

D Measurement

The City of Madison will measure Methyl Methacrylate Red by the square foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV. 0165.101	Methyl Methacrylate Red	SF

Payment is full compensation for all materials, labor and incidentals for providing the marking, in accordance with the drawings and as set forth in these specifications.

14-9 Skid/Slip Resistant Preformed Thermoplastic Pavement Marking, Bike Lane Green, Item SPV.0165.102.

A Description

This special provision describes furnishing and installing a durable, high skid and slip resistant preformed thermoplastic bike lane green pavement marking material for use on asphalt or Portland cement concrete pavement surfaces.

B Materials

B.1 General

Preformed thermoplastic pavement marking to be produced of the materials and by methods described below as manufactured by Ennis-Flint or approved equal.

The material must be produced in the United States, and the manufacturer must be ISO 9001:2008 certified for design, development and manufacturing of preformed thermoplastic pavement markings, and provide proof of current certification.

The material shall be capable of being applied on bituminous and/or Portland cement concrete pavements by the use of a handheld heat torch, and/or infrared heater without preheating the surface.

The material shall be capable of being applied in temperatures down to 45ºF (7.2ºC) without any special storage, preheating or treatment of the material before application.

The material must be a resilient light green color preformed thermoplastic product which contains a minimum of thirty percent (30%) intermixed anti-skid/anti-slip elements with a hardness range of 7-9 (Mohs scale), and where the top surface contains anti-skid/anti-slip elements with a hardness of 9 (Mohs scale).

Material shall be composed of an ester-modified rosin impervious to degradation by motor fuels, lubricants, etc., in conjunction with aggregates, pigments, binders, and anti-skid/anti-slip elements uniformly distributed throughout the material. The thermoplastic material shall conform to AASHTO designation M249, with the exception of the relevant differences due to the material being supplied in a preformed state, being non-reflective, and being of a color different from white or yellow.

B.2 Pigment Color

The bike lane green color shall be manufactured with appropriate pigment to ensure that the resulting colors complies with the Light Green color as specified in the FHWA Memorandum dated April 15th, 2011: Interim Approval for Optional Use of Green Colored Pavement for Bike Lanes (IA-14).

The pigment system must not contain heavy metals or any carcinogen, as defined in 29 CFR 1910.1200 in amounts exceeding permissible limits as specified in relevant Federal Regulations.

B.3 Heating Indicators

The top surface of the material shall have regularly spaced indents. The closing of these indents during application shall act as a visual cue that the material has reached a molten state, allowing for satisfactory adhesion and proper embedment of the anti-skid/anti-slip elements, and a post-application visual cue that proper application procedures have been followed.

B.4 Skid Resistance

The surface of the preformed thermoplastic material shall contain factory applied anti-skid elements with a minimum hardness of 9 (Mohs scale). Upon application, the material shall provide a minimum skid resistance value of 60 BPN when tested according to ASTM E 303.

B.5 Slip Resistance

The surface of the preformed thermoplastic material shall contain factory applied anti-skid elements with a minimum hardness of 9 (Mohs scale). Upon application the material shall provide a minimum static coefficient of friction of 0.6 when tested according to ASTM C 1028 (wet and dry), and a minimum static coefficient of friction of 0.6 when tested according to ASTM D 2047.

B.6 Thickness

The material must be supplied at a minimum thickness of 90 mils (2.29 mm) or 125 mils (3.15 mm).

B.7 Environmental Resistance

The material shall be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

C Construction

C.1 Construction Method

Install preformed thermoplastic pavement marking in accordance with manufacture's specifications.

C.2 Performance Requirements

Install preformed thermoplastic pavement marking per plans and specification. The engineer will notify the contractor within 48 hours of installation regarding any pavement marking not installed to specification or to the satisfaction of the engineer. Remove non-conforming preformed thermoplastic pavement marking and replace with a conforming product at no charge to the City of Madison.

D Measurement

The City of Madison will measure by the squared foot (SF) of preformed thermoplastic pavement marking installed and accepted.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid items:

ITEM NUMBER	DESCRIPTION	UNIT
SPV. 0165.102	Skid/Slip Resistant Preformed Thermoplastic Pavement Marking, Bike Lane Green	SF

Payment is full compensation for all work, materials, labor, and incidentals required to complete the work as specified, including any re-application or repair required under the performance requirements as provided herein.

15. Electrical.

15-1 Electrical Service Meter Breaker Pedestal.

Supplement standard spec 652 as follows:

656.2.1 General

Add the following text:

(5) Contractor shall submit power applications to Alliant Energy for all stations locations according to the power requirements as shown on the plans. Coordination with Alliant Energy has been completed through the design phase to identify Alliant Energy's preferred locations for the meter pedestals, transformers, CT cabinets, utility pads, service size, and source of power as shown in the plans. Contact Chris Gill, ChrisGill@alliantenergy.com, (608) 290-1772 for service questions. New electrical construction generally takes 10-weeks to 12-weeks, which generally begins 3-weeks after all required documents obtain approval by Alliant Energy. Submit applications as soon as possible to assure electrical service is installed, inspected, and ready for turn-on at the required date.

(6) Contractor shall submit power applications to MG&E for all stations locations according to the power requirements as shown on the plans. Coordination with MG&E has been completed through the design phase to identify MG&E's preferred locations for the meter pedestals, transformers, CT cabinets, utility pads, service size, and source of power as shown in the plans. Contact Mark Gauger, mgauger@mge.com, (608) 252-1570 for service questions. New electrical construction generally takes 10-weeks to 12-weeks, which generally begins 3-weeks after all required documents obtain approval

by MG&E. Submit applications as soon as possible to assure electrical service is installed, inspected, and ready for turn-on at the required date.

(7) Contractor shall submit power applications to Sun Prairie Utilities for all stations locations according to the power requirements as shown on the plans. Coordination with Sun Prairie Utilities has been completed through the design phase to identify Sun Prairie's preferred locations for the meter pedestals, transformers, CT cabinets, utility pads, service size, and source of power as shown in the plans. Contact Andrew Hirvela, ahirvela@myspu.com, (608) 837-5500 for service questions. New electrical construction generally takes 10-weeks to 12-weeks, which generally begins 3-weeks after all required documents obtain approval by Sun Prairie Utilities. Submit applications as soon as possible to assure electrical service is installed, inspected, and ready for turn-on at the required date.

656.2.6 Breaker Disconnect Box Service

Replace standard spec 656.2.5, Breaker Disconnect Box Service, paragraph (1) to read as follows:

(1) Furnish an approved network area electrical service having a meter socket and NEMA 3R 200A main breaker disconnect switch (22,000 AIC or larger as required by utility) or NEMA 3R 200A main fused disconnect switch, grounding electrodes and connections, conduit and fittings, channel support framing, conduit supports, foundation footings, and necessary conductors and equipment required by the WSEC and the utility for an underground service connection.

656.3.7 Breaker Disconnect Box Service

Replace standard spec 656.3.7, Breaker Disconnect Box Service, paragraph (1) to read as follows:

(1) Furnish connections and wiring to provide AC power to the bus shelter main circuit breaker in the cabinet from the bus located within the disconnect box. Mount service meter and disconnect box to a free-standing structure per local utility requirements.

15-2 Bid Alternate 2: Shelter Photovoltaic System, Item SPV.0060.316.

A Description

This special provision describes the bid alternate for furnishing and installing solar panels on station shelters. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems
263100 Photovoltaic System Performance Requirements

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Shelter Photovoltaic System under this section as each individual unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.316	Shelter Photovoltaic System	EACH

Payment is full compensation for all materials, labor and incidentals for installing the shelter photovoltaic system, including but not limited to the solar modules and arrays, inverters, mounting hardware, raceway, conductors and cables, circuit wiring connections, and fittings in accordance with the drawings and as set forth in these specifications for a finished and complete installation.

15-3 Electrical Wire Lighting 3/0 AWG, Item SPV.0090.301; Electrical Wire Lighting 4/0 AWG, Item SPV.0090.302.

A Description

This special provision describes furnishing and installing electrical wire lighting.

B Materials

Furnish conduit according to standard spec 655.2.

C Construction

Construct according to standard spec 655.3.

D Measurement

The City of Madison will measure the Electrical Wire Lighting 3/0 AWG bid items by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.301	Electrical Wire Lighting 3/0 AWG	LF
SPV.0090.302	Electrical Wire Lighting 4/0 AWG	LF

Payment for electrical wire lighting bid items is full compensation for providing electrical wire; for making connections; for providing connectors, including wire nuts, fuses, fuse holders, splices, tape, insulating varnish or sealant; and for testing the circuits.

15-4 Junction PNR Site Electrical, Item SPV.0105.301.

A Description

This special provision describes electrical work required at the Junction Road Park and Ride. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Junction PNR Site Electrical completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.301	Junction PNR Site Electrical	LS

Payment is full compensation for all materials, labor and incidentals for installing the site electrical work, including but not limited to the Electric Vehicle Charger electrical feed and connection, local bus shelter electrical feed and connection, Overhead Bus Chargers electrical feeds and connections, handholes, raceway, conductors and cables, circuit wiring connections, and fittings in accordance with the drawings and as set forth in these specifications for a finished and complete installation. Parking lot lighting, Restroom and Electrical building electrical work, Platform Shelter electrical work, and Utility Electrical Service not included in payment of the Junction PNR Site Electrical bid item.

15-5 Hanson Terminal Site Electrical, Item SPV.0105.302.

A Description

This special provision describes electrical work required at 3901 Hanson Road. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Hanson Site Electrical completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.302	Hanson Terminal Site Electrical	LS

Payment is full compensation for all materials, labor and incidentals for installing the site electrical work, including but not limited to Overhead Bus Charger electrical feed and connection, electrical feed from new Maintenance Facility Dist. Switchboard, handholes, raceway, conductors and cables, circuit wiring connections, and fittings in accordance with the drawings and as set forth in these specifications for a finished and complete installation. Hanson Electrical building electrical work, Platform Shelter work, and Hanson Maintenance Facility electrical work not included in payment of the Hanson Site Electrical bid item.

15-6 Sun Prairie PNR Site Electrical, Item SPV.0105.303.

A Description

This special provision describes electrical work at the Sun Prairie Park and Ride. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems

B (Vacant)

C (Vacant)

D Measurement

The City of Madison will measure Sun Prairie PNR Site Electrical completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.303	Sun Prairie PNR Site Electrical	LS

Payment is full compensation for all materials, labor and incidentals for installing the site electrical work, including but not limited to Overhead Bus Charger electrical feed and connection, handholes, raceway, conductors and cables, circuit wiring connections, and fittings in accordance with the drawings and as set forth in these specifications for a finished and complete installation. Restroom and Electrical building electrical work and Utility Electrical Service not included in payment of the Sun Prairie PNR Site Electrical bid item.

15-7 Electrical Service CT Cabinet (Segoe), SPV.0105.304; Electrical Service CT Cabinet (Wright), SPV.0105.305; Electrical Service CT Cabinet (Independence), SPV.0105.306.

A Description

This special provision describes furnishing and installing electrical equipment required to obtain service at station locations. See drawings and Architectural Special Provisions Package 1. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
033000 Cast-In-Place Concrete
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems

B Materials

Furnish an approved electrical service with an amperage capacity as shown on the plans having a pad-mount CT metering cabinet, grounding electrodes and connections, conduit and fittings, secondary cabling, concrete equipment pad, conduit supports, and all necessary equipment required by the WSEC and the

utility for an underground service connection. Furnish a utility approved CT cabinet and concrete equipment pad. The CT metering cabinet (transocket) shall include all equipment requirements as shown in the local utility service manual for service termination in a freestanding transocket. When the meter socket is energized, install an approved meter seal at all access points on the CT cabinet. Meter furnished by the utility.

C Construction

Provide cabling, raceway, and connections to provide shared AC power to the (2) bus shelter main circuit breaker in the cabinet from the bus located within the free-standing CT metering cabinet as shown on the plans. Mount CT metering cabinet to concrete pad per local utility requirements.

D Measurement

The City of Madison will measure Electrical Service CT Cabinet completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.304	Electrical Service CT Cabinet (Segoe)	LS
SPV.0105.305	Electrical Service CT Cabinet (Wright)	LS
SPV.0105.306	Electrical Service CT Cabinet (Independence)	LS

Payment is full compensation for all materials, labor and incidentals for installing the Electrical Service CT Cabinet, including but not limited to, the meter socket; and for manual bypass meter socket if required, CT metering cabinet, conduit raceway and fittings, conduit supports, secondary cables, handholes, concrete equipment pad, grounding electrodes, connections, trench and backfill, in accordance with the drawings, local utility requirements, and as set forth in these specifications for a finished and complete installation. Include charges by local utility company for permanent service as needed.

15-8 Junction PNR Electrical Service, Item SPV.0105.307; Sun Prairie PNR Electrical Service, Item SPV.0105.308.

A Description

This special provision describes furnishing and installing electrical equipment required to obtain service at the park and ride locations. See drawings and Architectural Special Provisions Package 2. Scope includes but is not limited to, the following sections:

012500 Substitution Procedures
013100 Project Management and Coordination
013300 Submittal Procedures
014000 Quality Requirements
016000 Product Requirements
017300 Execution
017700 Closeout Procedures
033000 Cast-In-Place Concrete
260500 Common Work Results for Electrical
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260544 Sleeves and Sleeve Seals for Electrical Raceways and Cabling
260553 Identification for Electrical Systems

B Materials

Furnish an approved electrical service with an amperage capacity as shown on the plans having a meter socket, free-standing CT metering cabinet (unless the local utility requires otherwise), service transformer (by local utility), grounding electrodes and connections, conduit and fittings, conduit supports, secondary cabling, equipment concrete pad, handholes, and necessary equipment required by the WSEC and the utility for an underground service connection. Furnish a utility approved CT metering cabinet (as required) and equipment pad for utility transformer & CT cabinet. The CT metering cabinet (transocket) shall include all equipment requirements as shown in the local utility service manual for service termination in a

freestanding transocket. When the meter socket is energized, install an approved meter seal at all access points on the CT cabinet. Meter furnished by the utility.

C Construction

Provide cabling, raceway, and connections to provide AC power to the switchboard main circuit breaker located within the site electrical building from the service bus located within utility transformer or the free-standing CT metering cabinet as shown on the plans. Provide a concrete pad for utility transformer and CT cabinet per local utility requirements. Mount CT cabinet to concrete pad.

D Measurement

The City of Madison will measure Electrical Service completed in accordance to the contract and accepted, as a single complete unit of work.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.307	Junction PNR Electrical Service	LS
SPV.0105.308	Sun Prairie PNR Electrical Service	LS

Payment is full compensation for all materials, labor and incidentals for installing the site Electrical Service, including but not limited to, the meter socket; and for manual bypass meter socket if required, free-standing CT metering cabinet, conduit raceway and fittings, conduit supports, secondary cables, handholes, conductors and cables, concrete pad for utility transformer & CT cabinet, grounding electrodes, connections, trench and backfill in accordance with the drawings, local utility requirements, and as set forth in these specifications for a finished and complete installation. Include charges by local utility company for permanent service as needed.

16. Street Lighting & Traffic Signal

16-1 General Requirements for Lighting Work

Unless otherwise indicated, State Specifications in this section shall be in reference to the State of Wisconsin Department of Transportation, Division of Highways, “Standard Specifications for Highway and Structure Construction”, Latest Edition, including Supplemental Specifications.

Contact City of Madison prior to starting street lighting construction.

City of Madison Contact – Jerry Schippa 608-266-4761

City of Madison lighting systems shall remain operational during construction at each BRT station.

16-2 Notice to Contractor – Traffic Signal & Lighting Equipment Lead Time.

Lead time for traffic signal equipment specified for this project are seeing lead times longer than typical time frame. Order equipment within two weeks of signed contract to assure the equipment is procured in a timely fashion to ensure the equipment is installed, inspected, and ready for turn-on at the required date.

16-3 Install Conduit into Existing Item, Item 652.0700.S.

A Description

This special provision describes installing proposed conduit into an existing manhole, pull box, junction box, communication vault, or other structure.

B Materials

Use Nonmetallic Conduit 2-Inch or 3-Inch or Conduit Special 3-Inch, as provided and paid for under other items in this contract. Furnish backfill material, topsoil, fertilizer, seed, and mulch conforming to the requirements of pertinent provisions of the standard specifications.

C Construction

Expose the outside of the existing structure without disturbing existing conduits or cabling. Drill the appropriate sized hole for the entering conduit(s) at a location within the structure without disturbing the existing cabling and without hindering the installation of new cabling within the installed conduit. Fill void

area between the drilled hole and conduit with an engineer-approved filling material to protect against conduit movement and entry of fill material into the structure. Tamp backfill into place.

D Measurement

The City of Madison will measure Install Conduit Into Existing System by the unit, acceptably installed. Up to five conduits entering a structure per entry point into the existing structure will be considered a single unit. Conduits in excess of five, or conduits entering at significantly different entry points into the existing pull box, manhole, or junction box will constitute multiple units of payment.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
652.0700.S	Install Conduit Into Existing Item	EACH

Payment is full compensation for excavating, drilling holes; furnishing and installing all materials, including bricks, coarse aggregate, sand, bedding, and backfill; for excavating and backfilling; and for furnishing and placing topsoil, fertilizer, seed, and mulch in disturbed areas; for properly disposing of surplus materials; and for making inspections.

16-4 Install Electrical Pull Box, Type I, Item SPV.0060.201; Install Electrical Pull Box, Type III, Item SPV.0060.202; Install Electrical Pull Box, Type V, Item SPV.0060.203; Install Electrical Pull Box, Type VII, Item SPV.0060.246.

A Description

This special provision describes transporting and installing electrical pull boxes in accordance to section 653 of the standard specifications, the plan details, and as hereinafter provided.

B Materials

Obtain electrical pull box from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install Electrical Pull Box (Type) in accordance to the pertinent provisions of section 653.3 of the standard specifications and the plan details.

D Measurement

The City of Madison will measure Install Electrical Pull Box (Type), by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.201	Install Electrical Pull Box Type I	EACH
SPV.0060.202	Install Electrical Pull Box Type III	EACH
SPV.0060.203	Install Electrical Pull Box Type V	EACH
SPV.0060.246	Install Electrical Pull Box Type VII	EACH

Payment is full compensation for transporting and installing all materials, and for furnishing all equipment and incidentals necessary to complete the work.

16-5 Concrete Base Type G, Item SPV.0060.204; Concrete Base Type LB-3, Item SPV.0060.205; Concrete Base Type LB-8, Item SPV.0060.206; Concrete Base Type P, Item SPV.0060.207; Concrete Bases Type LB-8 Raised, Item SPV.0060.239; Concrete Bases Type LB-SP, Item SPV.0060.245; Concrete Bases Type LB-3 Modified, SPV.0060.281; Concrete Bases Type LB-SP2, Item SPV.0060.282.

A Description

This special provision describes the construction of concrete foundations, including furnishing and installing necessary hardware, as shown on the plans, according to the pertinent provisions of standard spec 654, and as hereinafter provided.

B Materials

Furnish Grade A, A-WR, A-FA, or A-IP concrete masonry conforming to the requirements of standard spec 501. Conduit cast within the bases shall be Schedule 40 polyvinyl chloride (PVC) electrical conduit and shall conform to the requirements of standard spec 652.

Furnish anchor bolts for Type G and LB-3 modified bases made from high-strength steel (50 ksi minimum yield strength), ASTM A36, and fit each with two hard washers and two heavy hex nuts. Each bolt shall have approximately 3 inches or more of thread at the top end. The bolts, washers and nuts shall be galvanized.

Furnish anchor bolts for LB-SP, LB-SP2, LB-3, LB-8 raised, and LB-8 bases made from high-strength steel (50 ksi minimum yield strength), ASTM A36, and fit each with two hard washers and two heavy hex nuts. Each bolt shall have approximately 6 inches or more of thread at the top end. The bolts, washers, and nuts shall be galvanized.

Furnish 1 1/4-inch x 48-inch bolts for the LB-SP2, LB-8 bases, and LB-8 raised, including a 4-inch L-bend at the bottom. Furnish 1-inch x 40-inch bolts for the LB-3 and LP-SP bases, including a 4-Inch L-bend at the bottom. Furnish 3/4 inch x 19 inch bolts for the Type G bases. Furnish 3/4 inch x 30-inch bolt for the LB-3 modified bases, include a 4-inch L-bend at the bottom.

Include a concrete maintenance platform on the Type P bases. Generally, construct the Type P bases according to the standard detail drawing Concrete Control Cabinet Bases. Confirm the location of the conduits in the base with the City of Madison. Anchor bolts, nuts, and washers for Concrete Base, Type P, will be provided and installed by the contractor when installing signal control cabinets.

Conform bar steel reinforcement to the requirements of standard spec 505.

C Construction

Place the bases with one side parallel to the centerline of the street.

Forms shall be of sufficient depth to provide a minimum of 12 inches of formed base below the finished grade on the low side of the base. The top surface of the base shall be level with a 3/4-inch bevel on the edges and shall be given a rubbed finish.

Cast anchor bolts into the base as shown on the plans. Verify the bolt circle diameters before constructing the bases.

Furnish and install manufactured elbows in all bases, except as noted on the details. Install elbows to permit installation of conduit in as nearly straight-line runs as possible without unnecessary bends. Bases not installed to this standard will not be accepted.

Extend existing conduit into the bases. Elbows shall conform to the requirements of the type of conduit entering the base. Install an extra elbow in each base at the end of a run as directed by the engineer. Install extra elbows in any base as directed by the engineer.

Do not erect poles on the concrete bases until the bases have cured for at least seven days. All concrete bases require a rubbed finish down to finished grade.

D Measurement

The City of Madison will measure Concrete Base (Type) by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.204	Concrete Base Type G	EACH

SPV.0060.205	Concrete Base Type LB-3	EACH
SPV.0060.206	Concrete Base Type LB-8	EACH
SPV.0060.207	Concrete Base Type P	EACH
SPV.0060.239	Concrete Bases Type LB-8 Raised	EACH
SPV.0060.245	Concrete Bases Type LB-SP	EACH
SPV.0060.281	Concrete Bases Type LB-3 Modified	EACH
SPV.0060.282	Concrete Bases Type LB-SP2	EACH

Payment is full compensation for furnishing and installing all materials including conduit, bushings, caps and/or plugs, ground rod, anchor bolts, cadwelding, copper grounding wire; bar steel reinforcement, and concrete masonry; for providing openings through existing pavement where required; for excavation, including hand-digging as required, backfill, and disposal of surplus materials.

16-6 Install Pole 20-Foot 7 Gauge, Item SPV.0060.209; Install Pole 30-Foot 7 Gauge Single Mount, Item SPV.0060.210; Install Pole 30-Foot 7 Gauge Twin Mount, Item SPV.0060.211; Install Pole 30-Foot 11 Gauge Single Mount, SPV.0060.212; Install Pole 30-Foot 11 Gauge Twin Mount, Item SPV.0060.213; Install Pole 20-Foot 7 Gauge (Green), Item SPV.0060.247; Install Pole 30-Foot 7 Gauge Single Mount (Green), Item SPV.0060.248.

A Description

This special provision describes transporting and installing poles and arms according to standard spec 657, the details shown on the plans, and these special provisions.

B Materials

Obtain poles from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Set and plumb metal poles with the use of leveling nuts furnished with the anchor bolts. Level luminaires after erecting and leveling the metal standards with bracket arms. The proper leveling method may be obtained from the manufacturer's instruction manual. Torque nuts on anchor and transformer bolts to 175-200 foot pounds or as directed by the engineer. Provide rust, corrosion, and snit-seize protection at all threaded assemblies by coating and mating surfaces with Markal (hightemp – E-Z Break), Never-Seez (Marine Grade), LPS 100, Lubriplate, or approved equal.

Attach the stranded copper ground wire that is installed as a part of the base construction with an approved connector (Fargo GC 202 or approved equal) to a ground nut locate inside the pole opposite the handhole.

When transformer bases are not installed, trowel grout between the pole and concrete base and finished at an angle from the edge of the pole base to the outer edge of the foundation. Leave a ½ inch slot for drainage through the grouting on the street side at the top of the concrete base.

Cut the poles to modified lengths at the plan locations to meet OSHA clearance requirements at overhead transmission lines.

D Measurement

The City of Madison will measure Install Pole (description) as each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.209	Install Pole 20-Foot, 7 Gauge	EACH
SPV.0060.210	Install Pole 30-Foot, 7 Gauge Single Mount	EACH
SPV.0060.211	Install Pole 30-Foot, 7 Gauge Twin Mount	EACH
SPV.0060.212	Install Pole 30-Foot, 11 Gauge Single Mount	EACH
SPV.0060.213	Install Pole 30-Foot, 11 Gauge Twin Mount	EACH
SPV.0060.247	Install Pole 20-Foot, 7 Gauge (Green)	EACH
SPV.0060.248	Install Pole 30-Foot, 7 Gauge Single Mount (Green)	EACH

Payment is full compensation for transporting and installing according to standard spec 657.5. and for cutting poles to lengths less than 30 feet.

16-7 Install Poles Type 9-Special, Item SPV.0060.214; Install Monotube Arms 35-Foot Special, Item SPV.0060.215; Install Poles Type 10-Special, Item SPV.0060.275.

A Description

This section describes transporting and installing poles and monotube arms for traffic signals confirming to standard spec 657, details shown in the plan, and these special provisions

B Materials

The City of Madison will furnish monotube pole and monotube arms including mounting hardware, handhole covers, and pole caps.

Obtain monotube pole and monotube arms from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison as the plan shows and according to standard spec 654 and 657.

C Construction

Under each bid item, transport and install poles, ventilated pole caps, arms, and all necessary miscellaneous hardware needed to complete the installation of the poles and arms.

Install dampeners as the plans show and for poles and arms used in configurations susceptible to vibration. If the engineer determines that vibration is a problem after a pole and arm has been installed, install dampeners as the engineer directs.

After completing erection using normal pole shaft raking techniques, ensure that the centerline of the shaft is vertical.

Install equipment in accordance to standard spec 657.3.

Inspect according to 532.3.8 prior to opening to traffic.

D Measurement

The City of Madison will measure bid items under this section by each unit acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.214	Install Poles Type 9-Special	EACH
SPV.0060.215	Install Monotube Arms 35-Foot Special	EACH
SPV.0060.275	Install Poles Type 10-Special	EACH

Payment for Monotube Pole is full compensation for transporting and installing city furnished poles and for providing grounding lugs, fittings, shims, hardware, and other required components the City of Madison does not furnish.

Payment for the Install Monotube Arms is full compensation for transporting and installing city furnished arms; for testing and installing high strength bolt assemblies; and for providing related mounting hardware, leveling shims, and other required components the city does not furnish.

16-8 Install Traffic Signal Trombone Arm 15-Foot, Item SPV.0060.216; Install Traffic Signal Trombone Arm 20-Foot, Item SPV.0060.217; Install Traffic Signal Trombone Arm 22-Foot, Item SPV.0060.218; Install Traffic Signal Trombone Arm 25-Foot, Item SPV.0060.219; Install Traffic Signal Trombone Arm 15-Foot (Green), Item SPV.0060.251; Install Traffic Signal Trombone Arm 18-Foot (Green), Item SPV.0060.252; Install Traffic Signal Trombone Arm 20-Foot (Green), Item SPV.0060.253; Install Traffic Signal Trombone Arm 22-Foot (Green), Item SPV.0060.254; Install Traffic Signal Trombone Arm 25-Foot (Green), Item SPV.0060.255; Install Traffic Signal Trombone Arm 12-Foot, Item SPV.0060.265.

A Description

This special provision describes transporting and installing trombone mast arms and all necessary miscellaneous hardware needed to complete the installation of the trombone mast arm as shown on the plans, in the standard specifications, and as hereinafter provided.

B Materials

Obtain trombone arms from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install per manufacturer's instructions and in accordance to spec 657.3.

D Measurement

The City of Madison will measure Install Traffic Signal Trombone Arm Aluminum (length) by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.216	Install Traffic Signal Trombone Arm 15-Foot	EACH
SPV.0060.217	Install Traffic Signal Trombone Arm 20-Foot	EACH
SPV.0060.218	Install Traffic Signal Trombone Arm 22-Foot	EACH
SPV.0060.219	Install Traffic Signal Trombone Arm 25-Foot	EACH
SPV.0060.251	Install Traffic Signal Trombone Arm 15-Foot (Green)	EACH
SPV.0060.252	Install Traffic Signal Trombone Arm 18-Foot (Green)	EACH
SPV.0060.253	Install Traffic Signal Trombone Arm 20-Foot (Green)	EACH
SPV.0060.254	Install Traffic Signal Trombone Arm 22-Foot (Green)	EACH
SPV.0060.255	Install Traffic Signal Trombone Arm 25-Foot (Green)	EACH
SPV.0060.265	Install Traffic Signal Trombone Arm 12-Foot	EACH

Payment is full compensation transporting and installing all materials including all hardware, fittings, mounting clamps, shims and attachments necessary to completely install the mast arms.

16-9 Install Traffic Signal Heads 12-Inch, 3-Section, Item SPV.0060.220; Install Traffic Signal Heads 12-Inch, 4-Section, Item SPV.0060.221; Install Traffic Signal Heads 12-Inch, 5-Section, Item SPV.0060.222; Install Traffic Signal Heads 12-Inch, 3-Section Transit, Item SPV.0060.223; Install Traffic Signal Heads 16-Inch, Pedestrian with Countdown, Item SPV.0060.224.

A Description

This special provision describes transporting and installing vehicle and pedestrian signals with LED indications according to the standard specifications and these special provisions.

B Materials

Obtain traffic signal head equipment from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Construct according to standard spec 658 including assembly of traffic signal head equipment.

D Measurement

The City of Madison will measure Install Traffic Signal Heads (Description) by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.220	Install Traffic Signal Heads 12-Inch, 3-Section	EACH
SPV.0060.221	Install Traffic Signal Heads 12-Inch, 4-Section	EACH
SPV.0060.222	Install Traffic Signal Heads 12-Inch, 5-Section	EACH
SPV.0060.223	Install Traffic Signal Heads 12-Inch, 3-Section Transit	EACH
SPV.0060.224	Install Traffic Signal Heads 16-Inch, Pedestrian with Countdown	EACH

Payment is full compensation for transporting, assembly, and installing a complete and functioning assembly.

16-10 Install Backplates Signal Face, 3-Section 12-Inch, Item SPV.0060.225; Install Backplates Signal Face, 4-Section 12-Inch, Item SPV.0060.226; Install Backplates Signal Face, 5-Section 12-Inch, Item SPV.0060.227.

A Description

This special provision describes transporting and installing backplates for signal faces.

B Materials

Obtain backplates from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install the backplates according to standard spec 658.3, the manufacturer's instructions, and as shown on the plans.

D Measurement

The City of Madison will measure Install Backplates Signal Face (Description) 12-Inch by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.225	Install Backplates Signal Face 3-Section 12-Inch	EACH
SPV.0060.226	Install Backplates Signal Face 4-Section 12-Inch	EACH
SPV.0060.227	Install Backplates Signal Face 5-Section 12-Inch	EACH

Payment is full compensation for transporting and installing all materials.

16-11 Install Platform APS System 4 Push Buttons, Item SPV.0060.228.

A Description

This special provision describes transporting and installing APS system including 4 push buttons.

B Materials

Obtain APS system with 4 push buttons from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install APS Push Button Stations according to section 658.3.3 of the standard spec.

Install the APS Push Button Stations as shown on the plans and per manufacturer's instructions. For each push button location provide a 3/4-Inch diameter push button mounting hole for wiring purposes in standards or poles. De-burr the holes after sawing and before installing the wire.

Notify Chad Veinot of City of Madison at (608) 267-1960 upon completion of the installation of the APS Push Button Stations.

Provide the City of Madison audio files for the APS system.

D Measurement

The City of Madison will measure Install Platform APS System 4 Push Buttons by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.228	Install Platform APS System 4 Push Buttons	EACH

Payment is full compensation for transporting and installing of City of Madison furnished APS System and push buttons and for all labor, tools, equipment, and incidentals necessary to complete this item.

16-12 Install NEMA TS2 Type 1 Traffic Signal Control Cabinet, Item SPV.0060.229.

A Description

This special provision describes the transporting and installing of City furnished traffic signal cabinet as the plans show and as follows. Furnish and install at no extra cost any equipment and materials not specifically described but required in order to perform the intended functions in the cabinet.

B Materials

Use materials furnished by the City including: the traffic signal controller, traffic signal ethernet switch, Malfunction Management Unit (MMU), traffic signal cabinet, and other peripheral traffic signal cabinet equipment.

Obtain traffic signal cabinet and cabinet materials from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

Provide all other needed materials in conformance to 651.2, 652.2, 653.2, 654.2, 655.2, 656.2, 657.2, 658.2 and 659.2 of the standard specs.

C Construction

Perform work conforming to 651.3, 652.3, 653.3, 654.3, 655.3, 656.3, 657.3, 658.3 and 659.3 of the standard specs except as specified below.

Request a signal inspection of the completed signal installation to the project engineer at least five (5) working days prior to the time of the requested inspection. The City of Madison personnel will perform the inspection.

Coordinate directly with Chad Veinot of the City of Madison at (608) 267-1960 to schedule the cabinet acceptance testing. The City has final determination of the cabinet acceptance testing date and time.

Installation of traffic signal cabinet shall occur between 9:00am and 3:00pm unless otherwise approved by the engineer.

D Measurement

The City of Madison will measure Install NEMA TS2 Type 1 Traffic Signal Control Cabinet by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.229	Install NEMA TS2 Type 1 Traffic Controller Cabinet	EACH

Payment is full compensation for transporting and installing the traffic signal controller and the traffic signal cabinet; for furnishing and installing all other items necessary such as, but not limited to, wire nuts, splice kits and/or connectors, tape, insulating varnish, and ground lug fasteners. To make the proposed system complete from the source of supply to the most remote unit and for clean-up and waste disposal.

16-13 Install Traffic Signal Controller, Item SPV.0060.230.

A Description

This special provision describes transporting and installing a traffic signal controller with auxiliary equipment.

B Materials

Obtain traffic signal controller from the City of Madison at 3829 Hanson Rd, Madison, WI 53704.

C Construction

Perform work conforming to 651.3, 652.3, and 655.3 of the standard specs except as specified below.

Request a signal inspection of the completed signal installation to the project engineer at least five (5) working days prior to the time of the requested inspection. The City of Madison personnel will perform the inspection.

Coordinate directly with Chad Veinot of the City of Madison at (608) 267-1960 to schedule the controller acceptance testing. The City has final determination of the acceptance testing date and time.

D Measurement

The City of Madison will measure Install Traffic Signal Controller by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.230	Install Traffic Signal Controller	EACH

Payment is full compensation for transporting and installing the traffic signal controller, and all auxiliary equipment.

16-14 Optical Signal Preempt System, Item SPV.0060.231.

A Description

This special provision describes furnishing and installing optical signal preempt equipment at signalized intersections at the location and the quantity as shown on the plan.

B Materials

Furnish the following:

1. GTT Opticom Model 764 Multimode Phase Selector
2. GTT Opticom Model 711 Single Channel Optical Detector(s)

Furnish and install preemption detector cable, jumpers and any auxiliary equipment as necessary for a complete operating system.

C Construction

Install detectors on the top horizontal member of monotube arms, between the first and second traffic signal head, and as otherwise shown on the plan or as directed by Madison Traffic Engineering.

The detectors will generally be on the far side of the intersection, and aimed at approaching traffic, or as directed by Madison Traffic Engineering staff. Install detector cable from the detector to the control cabinet without splicing, using the shortest conduit path and leaving 5-ft slack at each handhole.

All installation methods to be consistent with the manufacturer’s instructions. Card rack and discriminator installation, as well as cabinet connections, will be made by the contractor.

Request an inspection of the installed system to the project engineer at least five (5) working days prior to the time of the requested inspection. The City of Madison personnel will perform the inspection.

D Measurement

The City of Madison will measure Optical Signal Preempt by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.231	Optical Signal Preempt System	EACH

Payment is full compensation for furnishing and installing detectors and cable; for furnishing and delivering discriminators, card racks, cables and miscellaneous materials to the City Traffic Engineering Field Office, 1120 Sayle Street.

16-15 Install LED Luminaire and Mounting Bracket Type I, Item SPV.0060.232; Install LED Luminaire and Mounting Bracket Type II, Item SPV.0060.233; Install LED Luminaire and Mounting Bracket Type III, Item SPV.0060.234; Install LED Luminaire and Mounting Bracket Type IV, Item SPV.0060.235; Install LED Luminaire and Mounting Bracket Type V, Item SPV.0060.236; Install LED Luminaire and Mounting Bracket Type VI, Item SPV.0060.237; Install LED Luminaire and Mounting Bracket Type A, Item SPV.0060.238; Install LED Luminaire and Mounting Bracket Type C, Item SPV.0060.240; Install LED Luminaire and Mounting Bracket Type D, Item SPV.0060.241.

A Description

This special provision describes transporting and installing luminaires and luminaire brackets/arms, as specified in standard specs 651, 655, and 659, as shown on the plans, and as provided hereinafter.

B Materials

Obtain luminaire and mounting brackets/arms from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install LED Luminaires and Mounting Bracket (Type) in accordance to the pertinent provisions of standard spec 659 and as the manufacturer's instructions.

D Measurement

The City of Madison will measure Install LED Luminaires and Mounting Bracket (Type) by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.232	Install LED Luminaire and Mounting Bracket Type I	EACH
SPV.0060.233	Install LED Luminaire and Mounting Bracket Type II	EACH
SPV.0060.234	Install LED Luminaire and Mounting Bracket Type III	EACH
SPV.0060.235	Install LED Luminaire and Mounting Bracket Type IV	EACH
SPV.0060.236	Install LED Luminaire and Mounting Bracket Type V	EACH
SPV.0060.237	Install LED Luminaire and Mounting Bracket Type VI	EACH
SPV.0060.238	Install LED Luminaire and Mounting Bracket Type A	EACH
SPV.0060.240	Install LED Luminaire and Mounting Bracket Type C	EACH
SPV.0060.241	Install LED Luminaire and Mounting Bracket Type D	EACH

Payment is full compensation for transporting and installing all materials, including all luminaires and pole mounting hardware.

16-16 Install Lighting Assembly Type III, SPV.0060.242.

A Description

This special provision describes transporting and installing a lighting assembly type III that includes decorative luminaire fixture, decorative shroud, and decorative luminaire arm including finial.

B Materials

The City of Madison will furnish decorative luminaire fixture, decorative shroud, and decorative luminaire arm with finial.

Obtain lighting assembly equipment from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

Note this item does not include the light pole.

C Construction

Construct in accordance to the applicable portions of standard spec 659 and the manufacturer's instructions.

D Measurement

The City of Madison will measure Install Lighting Assembly Type III by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.242	Install Lighting Assembly Type III	EACH

Payment is full compensation for transporting and installing all materials including hardware, fittings, mounting devices, and attachments necessary to completely install luminaire fixture, shroud, and luminaire arm with finial.

16-17 Removing Street Lighting Assembly, SPV.0060.243.

A Description

This special provision describes removing existing street light pole assemblies and electrical wire, in accordance to the pertinent provisions of section 204 of the standard specifications and as hereinafter provided.

B Materials (Vacant)

C Construction

Arrange for the de-energizing of the lighting system with the local utility after receiving approval from the engineer that the existing light pole assembly can be removed.

Contact Chad Veinot of the City of Madison at (608) 267-1960 at least five working days prior to the removal of the lighting assembly. Complete this work immediately following shut down of equipment.

Arrange a meeting to document the existing condition of street lighting that will be affected by construction activities

The City of Madison will provide the following information.

1. Identify all items to be salvaged or disposed.
2. Identify existing feed-point locations and circuit breaks.

When removing street lights, carefully remove and stockpile all equipment at a location approved by the engineer. Place all equipment on blocks so as not to be in direct contact with the ground. Protect luminaires from moisture. Properly dispose of any equipment that the city does not salvage including cabling/wiring. Replace any equipment damaged in the removal process with equipment that is of greater or equal quality than the damaged piece.

Deliver salvaged street light equipment to the City of Madison at 1120 Sayle Street Madison, WI 53715. Contact Ed Smith of City of Madison at (608) 266-9034 at least five working days prior to delivery to make arrangements.

Removing concrete bases will be paid for under a separate bid item.

D Measurement

The City of Madison will measure Removing Street Light Assembly by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.243	Removing Street Lighting Assembly	EACH

Payment is full compensation for removing light pole assembly, salvaging, transporting, disassembling, scrapping materials, disposing of scrap material and cabling/wiring.

16-18 Install Lighting Assembly Type III Pole, SPV.0060.244.

A Description

This special provision describes transporting and installing lighting assembly type III decorative pole.

B Materials

Obtain light pole from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Construct in accordance to the applicable portions of standard spec 659 and the manufacturer's instructions.

D Measurement

The City of Madison will measure Install Lighting Assembly Type III Pole by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.244	Install Lighting Assembly Type III Pole	EACH

Payment is full compensation for transporting and installing all materials including hardware, fittings, mounting devices, and attachments necessary to completely install light pole.

16-19 Install Traffic Signal Standards Aluminum 13-FT (Green), Item SPV.0060.249; Install Traffic Signal Standards Aluminum 15-FT (Green), Item SPV.0060.250; Install Traffic Signal Standards Aluminum 3.5-FT, Item SPV.0060.277; Install Traffic Signal Standards Aluminum 13-FT, Item SPV.0060.277; Install Traffic Signal Standards Aluminum 15-FT, Item SPV.0060.278; Install Traffic Signal Standards Aluminum 10-FT, Item SPV.0060.280.

A Description

This special provision describes transporting and installing standards and all necessary miscellaneous hardware needed to complete the installation of the standards as shown on the plans, in the standard specifications, and as hereinafter provided.

B Materials

Obtain standards from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install per manufacturer's instructions and in accordance to spec 657.3.

D Measurement

The City of Madison will measure Install Traffic Signal Standards Aluminum (length) by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.249	Traffic Signal Standards Aluminum 13-FT (Green)	EACH
SPV.0060.250	Traffic Signal Standards Aluminum 15-FT (Green)	EACH
SPV.0060.276	Traffic Signal Standards Aluminum 3.5-FT	EACH
SPV.0060.277	Traffic Signal Standards Aluminum 13-FT	EACH
SPV.0060.278	Traffic Signal Standards Aluminum 15-FT	EACH
SPV.0060.280	Traffic Signal Standards Aluminum 10-FT	EACH

Payment is full compensation for furnishing and installing the standards.

16-20 Install Pedestal Bases (Green), Item SPV.0060.256; Install Pedestal Bases, Item SPV.0060.273; Install Transformer Bases Breakaway 11 1/2-Inch Bolt Circle, Item SPV.0060.274.

A Description

This special provision describes transporting and installing bases and all necessary miscellaneous hardware needed to complete the installation of the bases as shown on the plans, in the standard specifications, and as hereinafter provided.

B Materials

Obtain bases from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install per manufacturer's instructions and in accordance to spec 657.3.

D Measurement

The City of Madison will measure Install Pedestal Bases (Green) by each individual unit, acceptably completed.

The City of Madison will measure Install Transformer Bases Breakaway 11 1/2-Inch Bolt Circle (Green) by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.256	Install Pedestal Bases (Green)	EACH
SPV.0060.273	Install Pedestal Bases	EACH
SPV.0060.274	Install Transformer Bases Breakaway 11 1/2-Inch Bolt Circle	EACH

Payment is full compensation for furnishing and installing all materials including the base, grounding lugs and related mounting hardware; for leveling shims; for corrosion prevention; and for disposal of surplus materials.

16-21 Salvage and Reinstall Lighting Assembly Item SPV.0060.258.

A Description

This special provision describes salvaging and reinstalling existing light pole as shown on the plans in accordance to the pertinent provisions of section 204 of the standard specifications and as hereinafter provided. Specific removal items are noted in the plans.

B (Vacant)

C Construction

Salvage lighting equipment and poles, including transformer bases, poles, luminaire arms, street signs, and luminaire fixtures per plan from their concrete footing and disassemble out of traffic. Remove wiring/cabling per plan. Ensure that access handhold doors and hardware remain intact. Make a reasonable effort to inspect salvaged equipment for damage or defects.

If damage or defects discovered, contact Chad Veinot of City of Madison at (608) 267-1960. The City assumes that all equipment is in good condition and in working order prior to the contractor's removal operation. Prior to removal, inspect and provide a list of any damaged or non-working traffic signal equipment to the engineer. Any equipment not identified as damaged or not working, prior to removal, will be replaced by the contractor at no cost to the City of Madison.

Remove all lighting wire from the conduit system as noted on the plan. Dispose of wire and cable.

Complete the removal work immediately following shut down of this equipment. All light poles shall be operational and lit during nighttime hours for the duration of the project. Once the existing light poles are disconnected and removed, the light poles must be reinstalled and reconnected to the system on the same working day so that the luminaires are operational and lit by the nighttime hours.

Reinstall the salvaged lighting equipment at the new locations shown on the plan and in accordance with sections 652.3, 657.3, 658.3, 659.3 of the standard specifications.

D Measurement

The City of Madison will measure Salvage and Reinstall Lighting Assembly by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.258	Salvage and Reinstall Lighting Assembly	EACH

Payment is full compensation for removing, disassembling lighting equipment, scrapping of some materials, disposing of scrap material, salvaging the equipment, stowing, projecting from damage, and reinstalling the lighting equipment at the new locations specified in the plan.

16-22 Salvage and Reinstall Microwave Detector Item SPV.0060.259.

A Description

This special provision describes salvaging and reinstalling a microwave detector at the locations shown on the plans.

B Materials

Furnish the manufacturer-required cable for the reinstallation of the microwave detector.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled salvage and reinstallation of microwave detector and all subsequent changes in operation. Install the microwave detector per plan. Install the detector manufacturer's connector cable whip from the detectors to the handhold or base. Contractor will install microwave detection equipment in the traffic signal control cabinet.

Vehicle detection programming will be performed by City of Madison. Notify Chad Veinot of City of Madison at (608) 267-1960 upon completion of the installation of the microwave detector.

D Measurement

The City of Madison will measure Salvage and Reinstall Microwave Detector by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.259	Salvage and Reinstall Microwave Detector	EACH

Contract unit price for salvage and reinstall microwave detector, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling microwave detector, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install microwave detection where indicated.

16-23 Salvage and Reinstall EVP Detector Item SPV.0060.260.

A Description

This special provision describes salvaging and reinstalling an EVP detector at the locations shown on the plans.

B Materials

Furnish the manufacturer-required cable for the reinstallation of the EVP detector.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled salvage and reinstallation of EVP detector and all subsequent changes in operation. Install the EVP detector per plan. Contractor will install microwave detection equipment in the traffic signal control cabinet.

EVP detector programming will be performed by City of Madison. Notify Chad Veinot of City of Madison at (608) 267-1960 upon completion of the installation of the EVP detector.

D Measurement

The City of Madison will measure Salvage and Reinstall EVP Detector by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.260	Salvage and Reinstall EVP Detector	EACH

Contract unit price for salvage and reinstall EVP detector, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling EVP detector, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install EVP detection where indicated.

16-24 Salvage and Reinstall Video Detection Camera Item SPV.0060.261.

A Description

This special provision describes salvaging and reinstalling a Video Detection Camera at the locations shown on the plans.

B Materials

Furnish the manufacturer-required cable for the reinstallation of the video detection camera.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled salvage and reinstallation of video detection camera and all subsequent changes in operation. Install the video detection camera per plan. Contractor will install video detection camera in the traffic signal control cabinet.

Vehicle detection programming will be performed by City of Madison. Notify Chad Veinot of City of Madison at (608) 267-1960 upon completion of the installation of the video detection camera.

D Measurement

The City of Madison will measure Salvage and Reinstall Video Detection Camera by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.261	Salvage and Reinstall Video Detection Camera	EACH

Contract unit price for salvage and reinstall video detection camera, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling video detection camera, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install video detection camera where indicated.

16-25 Salvage and Reinstall Gridsmart Detection Camera Item SPV.0060.262.

A Description

This special provision describes salvaging and reinstalling a Gridsmart Detection Camera at the locations shown on the plans.

B Materials

Furnish the manufacturer-required cable for the reinstallation of the video detection camera.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled salvage and reinstallation of Gridsmart detection camera and all subsequent changes in operation. Install the Gridsmart detection camera per plan. Contractor will install Gridsmart detection camera in the traffic signal control cabinet.

Vehicle detection programming will be performed by City of Madison. Notify Chad Veinot of City of Madison at (608) 267-1960 upon completion of the installation of the video detection camera

D Measurement

The City of Madison will measure Salvage and Reinstall Gridsmart Detection Camera by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.262	Salvage and Reinstall Gridsmart Detection Camera	EACH

Contract unit price for salvage and reinstall Gridsmart detection camera, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling Gridsmart detection camera, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install Gridsmart detection camera where indicated.

16-26 Salvage and Reinstall Wireless Antenna Item SPV.0060.263.

A Description

This special provision describes salvaging and reinstalling a wireless antenna at the locations shown on the plans.

B Materials

Furnish the manufacturer-required cable for the reinstallation of the wireless antenna.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled salvage and reinstallation of wireless antenna and all subsequent changes in operation. Install the wireless antenna per plan.

D Measurement

The City of Madison will measure Salvage and Reinstall Wireless Antenna by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.263	Salvage and Reinstall Wireless Antenna	EACH

Contract unit price for salvage and reinstall wireless antenna, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling wireless antenna, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install wireless antenna where indicated.

16-27 Install Lighting Control Cabinet, Item SPV.0060.264.

A Description

This special provision describes transporting and installing a lighting control cabinet with all electrical components and wiring assembled.

B Materials

Obtain lighting control cabinet from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, a minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Assemble the control cabinet as shown on the plans. Pretest the cabinet prior to transporting to the site. Mount all equipment to panel in enclosure. Train the cables in straight horizontal and vertical directions and be parallel next to and adjacent to other cables whenever possible. Mount the cabinet to the concrete base per the manufacturer's requirements. The work under this bid item includes connection and termination to the feeder system wiring.

D Measurement

The City of Madison will measure Install Lighting Control Cabinet by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.264	Install Lighting Control Cabinet	EACH

Payment is full compensation for transporting and installing photo control, contactors, panel, distribution blocks, surge arrestor, enclosure, grounding, wiring and electrical components; and for mounting to the concrete base.

16-28 Salvage and Reinstall PTZ Camera, Item SPV.0060.266.

A Description

This special provision describes salvaging and reinstalling a PTZ Camera at the locations shown on the plans.

B Materials

Furnish the manufacturer-required cable for the reinstallation of PTZ camera.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled salvage and reinstallation of PTZ camera and all subsequent changes in operation. Install the PTZ camera per plan.

D Measurement

The City of Madison will measure Salvage and Reinstall PTZ Camera by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.266	Salvage and Reinstall PTZ Camera	EACH

Contract unit price for salvage and reinstall PTZ camera, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling PTZ camera, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install PTZ camera where indicated.

16-29 Install EVP Detector, Item SPV.0060.267.

A Description

This special provision describes salvaging and installing an EVP detector at the locations shown on the plans.

B Materials

Obtain EVP detector head and cable from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled installation of EVP detector and all subsequent changes in operation. Install the EVP detector per plan. Contractor will install microwave detection equipment in the traffic signal control cabinet.

EVP detector programming will be performed by City of Madison. Notify Chad Veinot of City of Madison at (608) 267-1960 upon completion of the installation of the EVP detector.

D Measurement

The City of Madison will measure Install EVP Detector Head by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.267	Install EVP Detector	EACH

Contract unit price for installing EVP detector, shall be full compensation for furnishing all labor, equipment, supervision, salvaging and reinstalling EVP detector, furnishing cable, installation, touchup painting, cleanup, and all else necessary to install EVP detection where indicated.

16-30 Traffic Signal Controller Firmware Update, Item SPV.0060.271.

A Description

This special provision describes upgrading existing Cobalt traffic signal controllers to the latest firmware EOS.

B (Vacant)

C Construction

Perform work conforming to 651.3, 652.3, and 655.3 of the standard specs except as specified below.

Request a traffic signal controller firmware update inspection to the project engineer at least five (5) working days prior to the time of the requested inspection. The City of Madison personnel will perform the inspection.

Coordinate directly with Chad Veinot of the City of Madison at (608) 267-1960 to schedule the controller acceptance testing. The City has final determination of the acceptance testing date and time.

D Measurement

The City of Madison will measure Traffic Signal Controller Firmware Update by each individual unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.271	Traffic Signal Controller Firmware Update	EACH

Payment is full compensation for upgrading the existing Cobalt traffic signal controller to the latest firmware EOS, and all auxiliary equipment.

16-31 Install PTZ Camera, Item SPV.0060.272.

A Description

This special provision describes installing a PTZ Camera at the locations shown on the plans.

B Materials

Obtain PTZ camera and cable from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Notify Chad Veinot at least five working days prior to the scheduled installation of PTZ camera and all subsequent changes in operation. Install the PTZ camera per plan.

D Measurement

The City of Madison will measure Install PTZ Camera by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.272	Install PTZ Camera	EACH

Contract unit price installing PTZ camera, shall be full compensation for furnishing all labor, equipment, supervision, installation, touchup painting, cleanup, and all else necessary to install PTZ camera where indicated.

16-32 Install Pedestrian Push Buttons, Item SPV.0060.279.

A Description

This special provision describes installing pedestrian push buttons at the locations shown on the plans.

B Materials

Obtain push button from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Perform work confirming with 658.3 of the standard specs.

D Measurement

The City of Madison will measure Install Pedestrian Push Buttons by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.279	Install Pedestrian Push Buttons	EACH

Payment for pedestrian push button is full compensation for installing a complete and functioning assembly.

16-33 Salvage and Reinstall DMS Sign Assembly, Item SPV.0060.283.

A Description

This special provision describes salvaging and reinstalling DMS sign assembly on Campus Drive as shown on the plans in accordance to the pertinent provisions of section 204 of the standard specifications and as hereinafter provided. Specific removal items are noted in the plans.

B (Vacant)

C Construction

Salvage sign assembly, including pole, trombone arm, DMS sign, and beacons per plan from their concrete footing and disassemble out of traffic. Remove wiring/cabling per plan. Ensure that access handhold doors and hardware remain intact. Make a reasonable effort to inspect salvaged equipment for damage or defects.

If damage or defects discovered, contact Chad Veinot of City of Madison at (608) 267-1960. The City assumes that all equipment is in good condition and in working order prior to the contractor's removal operation. Prior to removal, inspect and provide a list of any damaged or non-working traffic signal equipment to the engineer. Any equipment not identified as damaged or not working, prior to removal, will be replaced by the contractor at no cost to the City of Madison.

Complete the removal work immediately following shut down of this equipment. Once the existing DMS sign is disconnected and removed, the sign assembly must be reinstalled and reconnected to the system with 5 working days.

Reinstall the salvaged equipment at the new locations shown on the plan and in accordance with sections 652.3, 657.3, 658.3, 659.3 of the standard specifications.

D Measurement

The City of Madison will measure Salvage and Reinstall DMS Sign Assembly by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.283	Salvage and Reinstall DMS Sign Assembly	EACH

Payment is full compensation for removing, disassembling equipment, scrapping of some materials, disposing of scrap material, salvaging the equipment, stowing, projecting from damage, and reinstalling a complete and functioning assembly.

16-34 Salvage and Reinstall Traffic Signal Head, Item SPV.0060.284.

A Description

This special provision describes removing, storing and protecting existing traffic signal head equipment and installing in accordance with the drawings and as hereinafter provided.

B Materials (Vacant)

C Construction

Arrange for de-energizing of the traffic signals with the local electrical utility after receiving approval from the engineer that the existing traffic signals can be removed.

Notify Chad Veinot of the City of Madison at (608) 267-1960 at least one week prior to the removal of the traffic signals. Complete the removal work as soon as possible following the shut down of this equipment. Arrange a meeting to document the existing condition of all materials that will be affected by construction activities.

Remove traffic signal heads, wiring/cable, and traffic signal mounting devices from each arm or pole. Keep hardware intact.

Replace any equipment damaged in the storage or relocating process with equipment that is of greater or equal quality than the damaged piece.

Reinstall traffic signal equipment, including traffic signal heads at the new location. If the equipment is not reinstalled the same day, store all materials removed in a safe and secure location as requested by the engineer. Protect from theft and damage.

D Measurement

The City of Madison will measure Salvage and Reinstall Traffic Signal Head, as a single lump sum unit of work, completed in accordance to the contract and accepted.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.284	Salvage and Reinstall Traffic Signal Head	EACH

Payment is full compensation for removing, storing, protecting, and reinstalling traffic signal head; for furnishing and installing materials including conduit, fittings, and any additional required mounting hardware; for making all connections; and for disposal of surplus materials.

16-35 Salvage and Deliver Traffic Signal Head, Item SPV.0060.285.

A Description

This special provision describes removing, storing and protecting existing traffic signal head equipment and delivery in accordance with the drawings and as hereinafter provided.

B Materials (Vacant)

C Construction

Arrange for de-energizing of the traffic signals with the local electrical utility after receiving approval from the engineer that the existing traffic signals can be removed.

Notify Chad Veinot of the City of Madison at (608) 267-1960 at least one week prior to the removal of the traffic signals. Complete the removal work as soon as possible following the shut down of this equipment. Arrange a meeting to document the existing condition of all materials that will be affected by construction activities.

Remove traffic signal heads, wiring/cable, and traffic signal mounting devices from each arm or pole. Keep hardware intact.

Replace any equipment damaged in the storage or relocating process with equipment that is of greater or equal quality than the damaged piece.

Deliver salvaged traffic signal equipment to the 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 at least five working days prior to delivery to make arrangements.

D Measurement

The City of Madison will measure Salvage and Deliver Traffic Signal Head, as a single lump sum unit of work, completed in accordance to the contract and accepted.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.285	Salvage and Deliver Traffic Signal Head	EACH

Payment is full compensation for removing, storing, protecting, and reinstalling traffic signal head; for furnishing and installing materials including conduit, fittings, and any additional required mounting hardware; for making all connections; and for disposal of surplus materials.

16-36 Loop Detector Lead-In Cable Special, Item SPV.0090.201.

A Description

This special provision describes furnishing and installing loop detector lead in cable according to standard spec 655.

B Materials

Furnish 0.25 inch diameter, 4-conductor, #18 AWG, waterproof, shielded, polypropylene insulation cable, with HDPE outer jacket, meeting IMSA specifications. Provide loop detector lead in cable to be smooth on the outside without any ripples or ribbing from cable wires.

C Construction

Install loop detector lead-in cables in accordance with section 655.3.8 of the standard specifications.

Furnish and install one cable for every two loops from each loop handhole to the intersection control cabinet via the most direct route, without intermediate splicing. Install cable for new and existing loops as shown on the plans. Verify cable needs with the City of Madison Traffic Engineering staff before completing intersection wiring.

D Measurement

The City of Madison will measure Loop Detector Lead-In Cable by the linear foot, acceptably completed, measured from the splice with the loop lead in wire along the centerline of the conduit to its connection with terminals in the control cabinet.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.201	Loop Detector Lead-In Cable Special	LF

Payment is full compensation for furnishing and installing all materials, and for furnishing all equipment and incidentals necessary to complete the work.

16-37 Electrical Wire Lighting 14-3 UF Grounded, Item SPV.0090.202.

A Description

This special provision describes furnishing and installing electrical wire lighting, 14-3 type UF cable according to standard spec 655 and these specifications.

B Materials

Furnish type UF cable with ground including the number and size of conductors as the plans show. Use cable conforming to ANSI/UL 493.

C Construction

Furnish and install one cable to each LED luminaire from base of pole to the luminaire.

D Measurement

The City of Madison will measure Electrical Wire Lighting 14-3 UF Grounded by the linear foot, acceptably completed, measured from the splice with the system lighting circuit in the pole base to the connection terminals in the luminaire.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.202	Electrical Wire Lighting 14-3 UF Grounded	LF

Payment is full compensation for furnishing and installing all materials, and for furnishing all equipment and incidentals necessary to complete the work.

16-38 Furnish and Install Fiber Optic Cable Outdoor Plant 12-CT, Item SPV.0090.203.

A Description

This special provision describes furnishing and installing pre-terminated Fiber Optic Terminal Block from new Traffic Control Cabinet to Existing City Fiber Optic Splice Point.

B Materials

Furnish 12 strand OS2 (ITU-T G.652D compliant) singlemode fiber optic cable assembly pre-terminated to LC-UPC connectors within sealed IP67 rated terminal block on side 1 – un-connectorized side 2. Jacket to be all dielectric outdoor duct rated material.

C Construction

Install fiber optic cable in conformance with Section 678.3.1 of the standard specifications. Contractor to make fiber splice as noted on the plans. Test Fiber Optic Connections in accordance with Section 678.3.4 of the standard specs.

D Measurement

The City of Madison will measure the Furnish and Install Fiber Optic Cable Outdoor Plant 12-CT bid items by the linear foot, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.203	Furnish and Install Fiber Optic Cable Outdoor Plan 12-CT	LF

Payment is full compensation for installing, transporting, testing City of Madison-furnished cabling and splicing.

16-39 Conduit HDPE Directional Bore 2-Ducts 3-Inch, Item SPV.0090.207.

A Description

This special provision describes furnishing and installing conduit HDPE Directional Bore 2-Ducts, 3-Inch.

B Materials

Furnish conduit according to standard spec 671.

C Construction

Construct according to standard spec 671.

D Measurement

The City of Madison will measure the Conduit HDPE Directional Bore 2-Ducts 3-Inch bid items by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.207	Conduit HDPE Directional Bore 2-Ducts 3-Inch	LF

Payment for Conduit HDPE Directional Bore bid items is full compensation for providing, hauling, and installing materials including conduit, fittings, couplers, and bends; for pull wires or ropes; for expansion fittings and caps; for excavating, bedding, backfilling, and restoration of ground to original condition including sand, concrete, or other required materials; and for making inspections.

16-40 Sawed in Bicycle Loop Detection, Item SPV.0090.209.

A Description

This special provision describes the process for sawing in slots for bicycle loop detection, furnishing and installing bicycle loop detector wires, and sealing bicycle loop detectors in existing concrete pavement.

B Materials

B.1 Loop Detector Wires

Furnish and install loop detector wires conforming to standard spec 655.2. Use 3 passes for each detection zone. Install loop detector wire directly into saw cut opening in pavement, do not use conduit to install loop detector wires.

B.2 Sealant

Provide a flowable polyester sealant MasterSeal SL-180 Polyester Traffic-Detector Loop Sealant Kit or equal as approved by the engineer for traffic loop detectors. The sealant shall be self-leveling, flowable to allow the sealant to cover the loop within the slot, shall be rated for exterior use, shall be applicable to concrete and asphalt applications, and shall be gray in color.

C Construction

The contractor shall saw slots into the concrete to a width no larger than 0.25 inch wide, and no deeper than 1.5 inches deep. There shall be a minimum of 0.5" of depth from the top of the detection wire to the surface of the concrete pavement.

The bicycle loop detection dimensions and shape are shown in the plans.

The contractor shall apply the sealant as described per the manufacturer's guidance, and finish flush with the surface, cleaning off any excess from the concrete.

D Measurement

The City of Madison will measure Sawed in Bicycle Loop Detection, by the LF of the cut including all work necessary to saw slot, furnish and install loop detector wire, and seal loop detector wire. Note the LF of sawing will not match the LF of detection wire.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.209	Sawed in Bicycle Loop Detection	LF

Payment is full compensation for sawing slots for bicycle loop detectors, furnishing and installing loop detector wire, and sealing.

16-41 Temporary Traffic Signal (High Point), Item SPV.0105.201; Temporary Traffic Signal (Randolph), Item SPV.0105.202; Temporary Traffic Signal (Westfield), Item SPV.0105.203; Temporary Traffic Signal (Gammon), Item SPV.0105.204; Temporary Traffic Signal (Grand Canyon), Item SPV.0105.205; Temporary Traffic Signal (Yellowstone), Item SPV.0105.206; Temporary Traffic Signal (Island), Item SPV.0105.207; Temporary Traffic Signal (Rosa), Item SPV.0105.208; Temporary Traffic Signal (Regent), Item SPV.0105.210; Temporary Traffic Signal (Midvale), Item SPV.0105.211; Temporary Traffic Signal (Blair), Item SPV.0105.231; Temporary Traffic Signal (Paterson), Item SPV.0105.232; Temporary Traffic Signal (Baldwin), Item SPV.0105.233; Temporary Traffic Signal (First), Item SPV.0105.234; Temporary Traffic Signal (Fourth Main), Item SPV.0105.235; Temporary Traffic Signal (Milwaukee), Item SPV.0105.236.Temporary Traffic Signal (Marquette), Item SPV.0105.237; Temporary Traffic Signal (Fair Oaks), Item SPV.0105.238; Temporary Traffic Signal (Mendota), Item SPV.0105.239; Temporary Traffic Signal (Springs), Item SPV.0105.290.

A Description

This special provision describes installing temporary traffic signals for intersections, using overhead electrical wiring to temporary traffic signal poles and temporary supports, and providing non-intrusive vehicle detection according to standard spec 661 and as amended herein. This special covers temporary lighting at the intersection including overhead conductors, arms, luminaires, supplying wood poles, maintaining wood poles, and removing wood poles.

B Materials

Furnish and use materials that are according to standard spec 661.2 and as amended herein.

B.1 Signal Poles and Signal Faces

Furnish new or used poles and traffic signal standards for use in temporary signals conforming to the pertinent requirements of standard spec 657 and 661. Furnish signal faces according to standard spec 661.2.2.2.

B.2 Signal Cabinet

Furnish new or equivalent to new materials as specified in standard spec 661.2 and as follows:

B.2.1 Controller

Furnish a new or equivalent to new Econolite Cobalt TS2 Type-1 controller with Telemetry Module. The controller shall be compatible with the City of Madison closed loop system (CLS).

B.2.2 Conflict Monitor

Furnish a new or equivalent to new NEMA+ 12-Channel Signal Conflict Monitor, with LCD display, and an Ejector Tab card release on side of card.

Provide keys to the temporary signal control cabinet to the City of Madison in addition to other required keys according to standard spec 661.2.1.

B.3 Luminaires

Furnish luminaire arms and luminaries conforming to the pertinent requirements of standard spec 657 and 659. The luminaries shall be 160-watt, full cutoff, LED and shall be furnished with photo electric cells to turn the luminaire on and off.

B.4 Emergency Vehicle Pre-emption Hardware, Cable, and Equipment

Furnish and install Optical signal preempt for the temporary signals that is compatible with the City's EVP systems. Each EVP detector as shown on plans will need EVP detector cable brought back individually to the signal control cabinet. Emergency Vehicle Pre-Emption intersection locations are shown on the plans.

B.5 Vehicle Detection Hardware, Cable and Equipment

The contractor, with prior approval of the engineer and the City of Madison, shall select the vehicle detection technology best suited for the site conditions and the anticipated construction work zones and activities. The engineer reserves the right to request a demonstration of any or all temporary vehicle detection technologies prior to said approval. Vehicle detection technologies considered shall include; but are not limited to, temporary inductive loops, microwave detection, or video detection. Detection technology shall provide for true presence detection.

Damage to new pavement for temporary detection loops will not be allowed. Any pavement damaged during installation shall be replaced at the contractor's expense.

C Construction

C.1 General

Construct temporary signal systems according to section 661.3 of the standard specifications and as hereinafter provided. Replace standard spec 661.3.1(2) with the following:

Request a signal inspection of the complete temporary traffic signal installation. Make this request to the City of Madison Electrical unit at 608-266-4767 at least 5 working days before the requested inspection. The City of Madison traffic signal personnel will perform the traffic signal inspection.

Arrange for monthly inspections with the engineer to review the height of the span wire above the roadways to ensure that the bottom of the traffic signal heads remain within the minimum and maximum heights allowed above the roadway as provided in the plans. Make all height adjustments within 24-hours of an inspection. Notify the engineer in writing upon completion of all necessary adjustments. Maintain a written log to properly document the date of each monthly inspection, the heights above the roadway, the roadway clearance after adjustments have been made and acceptance by the engineer.

Inspections can be more frequent than monthly as directed by the engineer.

The City of Madison will load the timing programs into the controller. Do not use new permanent signal conduit for temporary signal wiring. Provide horizontal and vertical clearance between sidewalks and guy wires.

Arrange for all required electrical service modifications with the utility. Pay all utility company installation costs for modifications required to maintain the Temporary Traffic Signal.

Locate and avoid all underground and aboveground utilities and structures. Install temporary supports as required to avoid conflicts with proposed curb and gutter, sidewalk, and traffic signal poles. The engineer will approve the final location of wood poles prior to installation.

Use of self-supporting poles will likely be required due to limited right-of-way limitations and depending on contractor operations.

Maintain temporary signals throughout the construction of the project, until such time that the new signals are operational and have been accepted by, and turned over to the city.

This item includes multiple configurations and re-installations of the temporary traffic signal. Allow for additional equipment on site to maintain temporary signal operations at all times during construction.

C.2 Signal Heads

Install signal heads for the same vehicle travel direction at a minimum of 11 feet from each other. Move signal heads as necessary or as directed by the engineer.

C.3 Cabinet

Require a representative from the cabinet supplier on-site at the time of the turn on. Install equipment in the cabinet as follows:

C.3.1 Controller

Install the controller and ensure that it is operational as part of the City of Madison closed loop system.

C.4 Luminaires

Install luminaire arms and luminaries conforming to the pertinent requirements of standard spec 657 and 659.

C.5 Pre-emption Hardware, Cable, and Equipment

Install detector cards, sensors, cables, and all required ancillary equipment, appurtenances and mounting hardware at the temporary signals to provide a fully functioning pre-emption system. Arrange testing of the pre-emption system with Chad Veinot of the City of Madison at (608) 267-1960, before turn-on of the temporary signal.

C.6 Vehicle Detection Hardware, Cable and Equipment

Install detector cards, sensors, cables and all required ancillary equipment, appurtenances and mounting hardware at the temporary signals to provide a fully functioning vehicle detection system for all approaches. The desired vehicle detection zones and temporary signal phasing are shown on the plans.

Arrange testing of the temporary detection system with Chad Veinot of City of Madison at (608) 267-1960, before turn-on of the temporary signal.

Adjust, relocate, add, or remove temporary vehicle detection equipment for each traffic control stage or sub stage as shown in the plans, requested by the engineer, or as modified by the contractor's operations to maintain the required traffic and complete the proposed work. Damage to new pavement for temporary detection loops will not be allowed. Any pavement damaged during installation shall be replaced at the contractor's expense.

If repairs or adjustments to restore vehicle detection to full function are not made the same day as notification, the associated pay item shall be reduced by the following amounts:

a) First instance: No deduct if repaired within 24 hours

b) Each subsequent instance: 5% deduct for each day or partial day of non-compliance.

C.7 Maintenance

When a signal installation or signal head is not in operation, hood, turn, or take down the signal head(s) to clearly indicate that the signal is not in operation. (See MUTCD 4D-1).

Provide immediate response, 24-hour/7-days per week, to maintain any aspect of the temporary vehicle detection that is defective, completing repairs or adjustment the same day as notification.

C.8 Contractor Qualifications

Demonstrate the ability to operate all required traffic signal equipment listed in this special provision for the engineer and the City of Madison prior to starting work. Provide proof of the ability to obtain all required traffic signal equipment listed in this special provision to the engineer and the City of Madison prior to starting work.

D Measurement

The City of Madison will measure Temporary Traffic Signals (Location), completed according to the contract and accepted, as each unit of work, and according to standard spec 661.4.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.201	Temporary Traffic Signal (High Point)	LS
SPV.0105.202	Temporary Traffic Signal (Randolph)	LS
SPV.0105.203	Temporary Traffic Signal (Westfield)	LS
SPV.0105.204	Temporary Traffic Signal (Gammon)	LS
SPV.0105.205	Temporary Traffic Signal (Grand Canyon)	LS
SPV.0105.206	Temporary Traffic Signal (Yellowstone)	LS
SPV.0105.207	Temporary Traffic Signal (Island)	LS
SPV.0105.208	Temporary Traffic Signal (Rosa)	LS
SPV.0105.210	Temporary Traffic Signal (Regent)	LS
SPV.0105.211	Temporary Traffic Signal (Midvale)	LS
SPV.0105.231	Temporary Traffic Signal (Blair)	LS
SPV.0105.232	Temporary Traffic Signal (Patterson)	LS
SPV.0105.233	Temporary Traffic Signal (Baldwin)	LS
SPV.0105.234	Temporary Traffic Signal (First)	LS
SPV.0105.235	Temporary Traffic Signal (Fourth Main)	LS
SPV.0105.236	Temporary Traffic Signal (Milwaukee)	LS
SPV.0105.237	Temporary Traffic Signal (Marquette)	LS
SPV.0105.238	Temporary Traffic Signal (Fair Oaks)	LS
SPV.0105.239	Temporary Traffic Signal (Mendota)	LS
SPV.0105.290	Temporary Traffic Signal (Springs)	LS

Payment is full compensation according to standard spec 661.5.

16-42 Removing Traffic Signal (High Point), Item SPV.0105.212; Removing Traffic Signal (Randolph), Item SPV.0105.213; Removing Traffic Signal (Westfield), Item SPV.0105.214; Removing Traffic Signal (Gammon), Item SPV.0105.215; Removing Traffic Signal (Grand Canyon), Item SPV.0105.216; Removing Traffic Signal (Yellowstone), Item SPV.0105.217; Removing Traffic Signal (Island), Item SPV.0105.218; Removing Traffic Signal (Rosa), Item SPV.0105.219; Removing Traffic Signal (Regent), Item SPV.0105.221; Removing Traffic Signal (Midvale), Item SPV.0105.222; Removing Traffic Signal (Springs), Item SPV.0105.223; Removing Traffic Signal (Randall), Item SPV.0105.224; Removing Traffic Signal (WB Orchard), Item SPV.0105.225; Removing Traffic Signal (Blair), Item SPV.0105.241; Removing Traffic Signal (Paterson), Item SPV.0105.242; Removing Traffic Signal (Baldwin), Item SPV.0105.243; Removing Traffic Signal (First), Item SPV.0105.244; Removing Traffic Signal (Fourth Main), Item SPV.0105.245; Removing Traffic Signal (Milwaukee), Item SPV.0105.246;Removing Traffic Signal (Marquette), Item SPV.0105.247; Removing Traffic Signal (Fair Oaks), Item SPV.0105.248; Removing Traffic Signal (Mendota), Item SPV.0105.249; Removing Traffic Signal (Portage), Item SPV.0105.250.

A Description

This special provision describes removing, salvaging, and transporting, existing traffic signal equipment at the intersection in accordance to the pertinent provisions of section 204 of the standard specifications and as hereinafter provided. Specific removal items are noted in the plans.

B Materials (Vacant)

C Construction

Arrange for the de-energizing of the traffic signals with the local electrical utility after receiving approval from the engineer that the existing traffic signals and lighting can be removed.

Notify Chad Veinot with the City of Madison at (608) 267-1960 at least five working days prior to the removal of the traffic signals. Complete the removal work as soon as possible following shut down of this equipment.

Arrange a meeting to document the existing condition of all traffic signal equipment that will be affected by construction activities. Only items that could be identified to be salvaged are traffic signal poles, trombone arms, and luminaire arms. All other items will be disposed by the contractor.

Remove and dispose cabling/wiring, loop detector wire and lead, etc.

The City of Madison will provide the following information.

1. Identify all items to be salvaged or disposed (Only traffic signal poles, trombone arms, and luminaire arms).
2. Identify existing feed-point locations and circuit breaks.

When removing traffic signals, carefully remove and stockpile all equipment at a location approved by the engineer. Place all equipment on blocks so as not to be in direct contact with the ground. Protect luminaires and signal heads from moisture. Properly dispose of any equipment that the city does not salvage. Replace any equipment damaged in the removal process with equipment that is of greater or equal quality than the damaged piece.

Deliver salvaged traffic signal equipment to the 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 at least five working days prior to delivery to make arrangements.

D Measurement

The City of Madison will measure Removing Traffic Signals (Location) as a single lump sum unit of work, completed in accordance to the contract and accepted.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.212	Removing Traffic Signal (High Point)	LS
SPV.0105.213	Removing Traffic Signal (Randolph)	LS
SPV.0105.214	Removing Traffic Signal (Westfield)	LS
SPV.0105.215	Removing Traffic Signal (Gammon)	LS
SPV.0105.216	Removing Traffic Signal (Grand Canyon)	LS
SPV.0105.217	Removing Traffic Signal (Yellowstone)	LS
SPV.0105.218	Removing Traffic Signal (Island)	LS
SPV.0105.219	Removing Traffic Signal (Rosa)	LS
SPV.0105.221	Removing Traffic Signal (Regent)	LS
SPV.0105.222	Removing Traffic Signal (Midvale)	LS
SPV.0105.223	Removing Traffic Signal (Springs)	LS
SPV.0105.224	Removing Traffic Signal (Randall)	LS
SPV.0105.225	Removing Traffic Signal (WB Orchard)	LS
SPV.0105.241	Removing Traffic Signal (Blair)	LS
SPV.0105.242	Removing Traffic Signal (Patterson)	LS
SPV.0105.243	Removing Traffic Signal (Baldwin)	LS
SPV.0105.244	Removing Traffic Signal (First)	LS
SPV.0105.245	Removing Traffic Signal (Fourth Main)	LS
SPV.0105.246	Removing Traffic Signal (Milwaukee)	LS
SPV.0105.247	Removing Traffic Signal (Marquette)	LS
SPV.0105.248	Removing Traffic Signal (Fair Oaks)	LS
SPV.0105.249	Removing Traffic Signal (Mendota)	LS
SPV.0105.250	Removing Traffic Signal (Portage)	LS

Payment is full compensation for removing, salvaging, transporting, disassembling traffic signals, scrapping of some materials, disposing of scrap material, delivering the requested materials to the City, and incidentals necessary to complete the contract work.

16-43 Salvage and Reinstall EVP System Item SPV.0105.252.

A Description

This special provision describes salvaging and reinstalling existing EVP system in accordance to the pertinent provisions of section 204 of the standard specifications and as hereinafter provided.

B Materials

Furnish new EVP detector cable for reinstallation of EVP detector heads.

C Construction

Install the EVP detector heads and EVP detector cable as shown on the plan. Final determination of location will be made by the City of Madison electrical personnel. Install equipment according to manufacturer's instructions to provide a fully operational system. Contractor to complete all connections in the signal cabinet and programing of the signal controller.

Coordinate with Chad Veinot of City of Madison at (608) 267-1960 to arrange testing of each receiver and the overall preemption system. Adjust detectors and other system equipment to provide the specified detection ability.

D Measurement

The City of Madison will measure Salvage and Reinstall EVP System bid items as a single lump sum unit of work, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.252	Salvage and Reinstall EVP System	LS

Contract unit price for install emergency vehicle preemption system, per lump sum shall be full compensation for furnishing new EPV detector cable and all labor for salvaging and reinstalling, equipment, EVP detector heads, detector mounts, and EVP detector cable, installation, touchup painting, cleanup, and all else necessary to install emergency vehicle preemption where indicated.

16-44 Install Gridsmart Detection System, Mineral Point & Westfield Rd Item SPV.0105.254; Install Gridsmart Detection System, Mineral Point & Island Dr Item SPV.0105.255.

A Description

This special provision describes transporting and installing a Gridsmart detection system at the locations shown on the plans.

B Materials

Obtain video detection Gridsmart camera, Gridsmart system processor and cables from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install the traffic signal power cable, the camera manufacturer's connector cable whip, pole/arm mounting bracket, extension arm (if required) and camera as shown on the plans. Camera shall be mounted at a minimum 30' height. Install video detection equipment in the traffic signal control cabinet.

Install the traffic signal power cable to run continuously (without splices) form the traffic signal cabinet base to the video detection camera. Leave 10 feet of cable in each pull box.

Mark each end of the lead appropriately to indicate the equipment label (i.e. VID1).

Camera programming will be performed by City of Madison. Notify Chad Veinot with the City of Madison at (608) 267-1960, upon completion of the installation of video detection system components.

D Measurement

The City of Madison will measure the Install Gridsmart Detection System, (Location) as a single lump sum unit of work acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.254	Install Gridsmart Detection System, Mineral Point & Westfield Rd	LS
SPV.0105.255	Install Gridsmart Detection System, Mineral Point & Island Dr	LS

Contract unit price for install Gridsmart detection system, per lump sum shall be full compensation for furnishing all labor, equipment, supervision, transport of City of Madison provided video detection cameras and cable, installation, touchup painting, cleanup, and all else necessary to install vehicular video detection where indicated.

16-45 Temporary Street Lighting, Item SPV.0105.256.

A Description

This special provision describes providing a temporary lighting system at all the locations specified in the plans. Provide all labor, material, and equipment necessary to furnish, install, maintain, and remove the temporary lighting system.

B Materials

Provide all necessary materials required to install a complete and operational temporary lighting systems consisting of any combination of the following new or existing lighting equipment: wood poles, luminaires, luminaire arms, overhead cable, risers, guy wires, conduit, pull boxes, direct buried concrete poles, decorative lighting assemblies, and all necessary equipment and connections.

Furnish Wood Poles Class 4 and guy wires conforming to standard spec 661. Furnish and install guy wires and support cables at all wood poles that have aerial power cables.

Furnish all lighting equipment as shown on the plan and plan details from WisDOT's approved products list and conforming to 657.2 and 659.2 of the standard specifications.

Provide overhead service conductor assembly, including a messenger cable, insulated conductor wires, ground wires, a jacket, and conductor lashing as shown in the plan details. Provide a messenger wire consisting of:

1. Seven strands of extra high strength (EHS) grade, galvanized (zinc coating weight per ASTM A 90) steel wire
2. 3/8 inch nominal diameter
3. Minimum strand break load 26,900 lbf
4. Critical tension 25,000 lb
5. Meets or exceeds ASTM A 475 and ASTM A 363 standards

Provide annealed (soft) copper, type SE, 600 volt, conductor wires and ground wires, of the size noted in the plans. Provide sunlight resistant Type XHHW-2 insulation for the conductor wires. Provide wires in a jacket of sunlight resistant gray polyvinyl chloride.

Provide stainless steel tie straps for lashing the conductor assembly.

Provide materials at each station listed below and as shown in the plans and as specified herein.

- Mineral Point Road & High Point Road
- Mineral Point & Gammon Road
- Mineral Point & Island Drive
- Mineral Point & Whitney Way
- EB State Street & Johnson Street
- E Washington Avenue & Marquette Street
- E Washington Avenue & East Springs

C Construction

The temporary lighting units at the BRT locations identified in the plans shall remain operational every night for the duration of the project as long as the roadway and sidewalk affected by the temporary lighting are in use. Overnight outages are not permitted.

Temporary lighting shall provide lighting levels equal to or exceeding the existing lighting levels and quality by using the same luminaire quantity and type as existing until the new lighting system is energized.

Install wood poles, guy, span, and messenger wire, and mountain hardware conforming to standard spec 661.3. Install all hardware as represented on the plans and all grounding components per National Electric Code.

Install lighting equipment as shown on plans and in the plan details conforming to 657.3 and 659.3 of the standard specifications.

Assemble and install the conductor assembly as shown in the plans and in the plan details. Maintain overhead clearances, including wire sag, as shown on the plans. Install wires in conduit on poles and make connections. Verify the span height throughout the project duration.

Arrange for all required electrical service modifications with the utility.

Request a lighting inspection of the complete temporary lighting system installation. Make request to the engineer at least 5 working days before requested inspection.

Provide contact information for the city and police department for repair purposes and be able to respond within 2 hours to the project site for a knockdown. All other maintenance needs shall be completed within 24 hours of notification.

Cable splicing and luminaire fusing shall be submitted for approval.

Determine the exact location of existing conduit runs and pull boxes before using equipment that may damage such facilities or interfere with existing system operations. Existing lighting installations to be removed may need to be kept in operation to provide temporary lighting until proposed lighting system is installed and operational.

All circuits outside of the project scope shall stay energized without interruption. If damage is caused by contractor's operations, damaged facilities shall be repaired or replaced promptly at no additional compensation.

After the permanent lighting system has been installed, energized, and approved for each station, remove completely all temporary lighting equipment used for temporary lighting.

D Measurement

The City of Madison will measure Temporary Street Lighting as a single lump sum unit of work acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.256	Temporary Street Lighting	LS

Payment is full compensation for furnishing, installing, operating, maintaining, and removing the temporary lighting system and for backfilling and restoring the site to match surroundings. Grounding components, guy wires, support cables, and rigid metallic conduit are incidental to this item. Payment also includes all utility charges for installation and disconnection through project completion.

16-46 Install Signal Mounting Hardware (Junction), Item SPV.0105.261; Install Signal Mounting Hardware (High Point), Item SPV.0105.262; Install Signal Mounting Hardware (Randolph), Item SPV.0105.263; Install Signal Mounting Hardware (Westfield), Item SPV.0105.264; Install Signal Mounting Hardware (Gammon), Item SPV.0105.265; Install Signal Mounting Hardware (Grand Canyon), Item SPV.0105.266; Install Signal Mounting Hardware (Yellowstone), Item SPV.0105.267; Install Signal Mounting Hardware (Island), Item SPV.0105.268; Install Signal Mounting Hardware (Rosa), Item SPV.0105.269; Install Signal Mounting Hardware (Regent), Item SPV.0105.270; Install Signal Mounting Hardware (Sheboygan), Item SPV.0105.271; Install Signal Mounting Hardware (Segoe), Item SPV.0105.272; Install Signal Mounting Hardware (Midvale), Item SPV.0105.273; Install Signal Mounting Hardware (Randall), Item SPV.0105.274; Install Signal Mounting Hardware (WB Orchard), Item SPV.0105.275; Install Signal Mounting Hardware (Blair), Item SPV.0105.276; Install Signal Mounting Hardware (Paterson), Item SPV.0105.277; Install Signal Mounting Hardware (Baldwin), Item SPV.0105.278; Install Signal Mounting Hardware (First), Item SPV.0105.279; Install Signal Mounting Hardware (Fourth Main), Item SPV.0105.280; Install Signal Mounting Hardware (Milwaukee), Item SPV.0105.281;Install Signal Mounting Hardware (Marquette), Item SPV.0105.282; Install Signal Mounting Hardware (Melvin), Item SPV.0105.283; Install Signal Mounting Hardware (Fair Oaks), Item SPV.0105.284; Install Signal Mounting Hardware (Anderson), Item SPV.0105.285; Install Signal Mounting Hardware (Mendota), Item SPV.0105.286; Install Signal Mounting Hardware (Portage), Item SPV.0105.287; Install Signal Mounting Hardware (Independence), Item SPV.0105.288; Install Signal Mounting Hardware (Springs), Item SPV.0105.289.

A Description

This special provision describes transporting and installing signal mounting hardware per intersection.

B Materials

Obtain signal mounting hardware from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install the signal mounting hardware according to standard spec 658.3, the manufacturer's instructions, and as shown on the plans.

D Measurement

The City of Madison will measure Install Signal Mounting Hardware (Location) as a single lump sum unit of work acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.261	Install Signal Mounting Hardware (Junction)	LS
SPV.0105.262	Install Signal Mounting Hardware (High Point)	LS
SPV.0105.263	Install Signal Mounting Hardware (Randolph)	LS
SPV.0105.264	Install Signal Mounting Hardware (Westfield)	LS
SPV.0105.265	Install Signal Mounting Hardware (Gammon)	LS
SPV.0105.266	Install Signal Mounting Hardware (Grand Canyon)	LS
SPV.0105.267	Install Signal Mounting Hardware (Yellowstone)	LS
SPV.0105.268	Install Signal Mounting Hardware (Island)	LS
SPV.0105.269	Install Signal Mounting Hardware (Rosa)	LS
SPV.0105.270	Install Signal Mounting Hardware (Regent)	LS
SPV.0105.271	Install Signal Mounting Hardware (Sheboygan)	LS
SPV.0105.272	Install Signal Mounting Hardware (Segoe)	LS
SPV.0105.273	Install Signal Mounting Hardware (Midvale)	LS
SPV.0105.274	Install Signal Mounting Hardware (Randall)	LS
SPV.0105.275	Install Signal Mounting Hardware (WB Orchard)	LS
SPV.0105.276	Install Signal Mounting Hardware (Blair)	LS
SPV.0105.277	Install Signal Mounting Hardware (Patterson)	LS
SPV.0105.278	Install Signal Mounting Hardware (Baldwin)	LS
SPV.0105.279	Install Signal Mounting Hardware (First)	LS
SPV.0105.280	Install Signal Mounting Hardware (Fourth Main)	LS
SPV.0105.281	Install Signal Mounting Hardware (Milwaukee)	LS
SPV.0105.282	Install Signal Mounting Hardware (Marquette)	LS
SPV.0105.283	Install Signal Mounting Hardware (Melvin)	LS
SPV.0105.284	Install Signal Mounting Hardware (Fair Oaks)	LS
SPV.0105.285	Install Signal Mounting Hardware (Anderson)	LS
SPV.0105.286	Install Signal Mounting Hardware (Mendota)	LS
SPV.0105.287	Install Signal Mounting Hardware (Portage)	LS
SPV.0105.288	Install Signal Mounting Hardware (Independence)	LS
SPV.0105.289	Install Signal Mounting Hardware (Springs)	LS

Payment is full compensation for transporting and installing all materials.

16-47 Install Electrical Service Meter Breaker Pedestal (Junction), Item SPV.0105.291; Install Electrical Service Meter Breaker Pedestal (High Point), Item SPV.0105.292; Install Electrical Service Meter Breaker Pedestal (Westfield), Item SPV.0105.293; Install Electrical Service Meter Breaker Pedestal (Grand Canyon), Item SPV.0105.295; Install Electrical Service Meter Breaker Pedestal (Island), Item SPV.0105.296; Install Electrical Service Meter Breaker Pedestal (Rosa), Item SPV.0105.297; Install Electrical Service Meter Breaker Pedestal (Regent), Item SPV.0105.298; Install Electrical Service Meter Breaker Pedestal (Sheboygan), Item SPV.0105.299; Install Electrical Service Meter Breaker Pedestal (Segoe), Item SPV.0105.2000; Install Electrical Service Meter Breaker Pedestal (Melvin), Item SPV.0105.2001; Install Electrical Service Meter Breaker Pedestal (Independence), Item SPV.0105.2002.

A Description

This special provision describes transporting and installing electrical meter breaker pedestal.

B Materials

Obtain meter breaker pedestals from the City of Madison at 3829 Hanson Rd, Madison, WI 53704. Contact Ed Smith of City of Madison at (608) 266-9034 to make arrangements for picking up the furnished materials, minimum of three working days prior to picking the materials up. Furnish any hardware not provided by the City of Madison.

C Construction

Install electrical meter breaker pedestal according to standard spec 656.3, the manufacturer's instructions, and as shown on the plans.

D Measurement

The City of Madison will measure Install Electrical Service Meter Breaker Pedestal (Location) as a single lump sum unit of work acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0105.291	Install Electrical Service Meter Breaker Pedestal (Junction)	LS
SPV.0105.292	Install Electrical Service Meter Breaker Pedestal (High Point)	LS
SPV.0105.293	Install Electrical Service Meter Breaker Pedestal (Westfield)	LS
SPV.0105.295	Install Electrical Service Meter Breaker Pedestal (Grand Canyon)	LS
SPV.0105.296	Install Electrical Service Meter Breaker Pedestal (Island)	LS
SPV.0105.297	Install Electrical Service Meter Breaker Pedestal (Rosa)	LS
SPV.0105.298	Install Electrical Service Meter Breaker Pedestal (Regent)	LS
SPV.0105.299	Install Electrical Service Meter Breaker Pedestal (Sheboygan)	LS
SPV.0105.2000	Install Electrical Service Meter Breaker Pedestal (Segoe)	LS
SPV.0105.2001	Install Electrical Service Meter Breaker Pedestal (Melvin)	LS
SPV.0105.2002	Install Electrical Service Meter Breaker Pedestal (Independence)	LS

Payment is full compensation for transporting and installing all materials including meter breaker pedestal, manual bypass meter socket, conduit and fittings, circuit breakers, grounding electrodes and connections.

17. Landscaping.

17-1 Landscape Planting Surveillance and Care Cycles.

If the care specialist fails to perform any of the required care cycles as specified in the standard spec 632.3.19.1, the City of Madison will assess daily damages in the amount of $200.00 to cover the cost of performing the work with other forces. The City of Madison will assess these damages for each day the requirements of the car cycle remain incomplete, including each additional day if the engineer extends the required time period.

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A surveillance and care cycle is defined as a 2 week interval from May to October. A care cycle covers all vegetation on the project including trees, shrubs, perennials & native grasses, plugs, and seeding. The number of and duration between surveillance and care cycles may be reduced or extended by the Project Engineer as conditions dictate.

Add the following to standard spec 632.3.19.1(7):

Follow safe usage, application rates, and application methods per product specifications. Take precautions to avoid pesticide contamination on flowering plants near treatment areas. Alert the engineer 48 hours prior to applying pesticide.

17-2 Red Granite Chips, Item SPV.0035.003.

A Description

This special provision describes installing red granite chips around trees in the terrace at the locations as indicated on the plans.

B Materials

The contractor shall submit samples of Red Granite Chips in making a final selection of color The color shall match with the existing Granite Chips. Red Granite Chips shall be angular crushed red granite graded as flows:

Sieve Size	% Passing
9/16”	98.0%
3/8”	67.0%
#4	13.0%
#8	3.0%
#16	<1.0%

C Construction

Clean and clear subgrade by removing weeds from the area. Spread Red Granite Chips over the subgrade to a depth of 4” and compacted firm. Red Granite Chips shall slope down minimum 1% towards tree trunk; thickness shall be reduced near tree trunk.

D Measurement

The City of Madison will measure by the cubic yard, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0035.003	Red Granite Chips	CY

Payment includes all equipment, labor and materials necessary to complete this item as specified.

17-3 Tree Protection, Item SPV.0060.501.

A Description

This special provision describes the protection of trees at locations as indicated on the plans. All tree protection shall be coordinated with City Forester, including inspection of tree protection measures.

B Materials

Add the following City of Madison standard spec 107.13:

Use orange construction type fencing that is 4-foot in height with steel supporting posts 5-foot to 8-foot on center for tree protection fencing. Furnish all other materials necessary to erect the fencing.

C Construction

Follow City of Madison standard spec 107.13.

D Measurement

The City of Madison will measure Tree Protection as each individual Tree Protection, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.501	Tree Protection	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

17-4 Tree Grates, Item SPV.0060.502.

A Description

This special provision describes providing all labor, materials and equipment required to furnish and install cast iron tree grates and their frames as shown on City of Madison standard detail drawing 3.15. All tree grates installation shall be coordinate with City Forester.

B Materials

Tree grates shall be cast iron per ASTM A48 class 35B or better. Standard finish is raw cast grey iron. Tree grate shall be ADA compliant, provide with angle frame and rebar. Casting shall be:

R-8815-A (4’ x 8’ rectangle)

Approved product shall be from Neenah Foundry Co. P.O. Box 729, 2121 Brooks Ave. Neenah, WI 54957, 920-725-7000, or Approved equal.

C Construction

Follow City of Madison standard spec 303.2(o).

D Measurement

The City of Madison will measure Tree Grates by each unit, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.502	Tree Grates	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

17-5 Trees, Item SPV.0060.504; Shrubs, Item SPV.0060.506; Perennials & Grasses, Item SPV.0060.507; Plug Mix, Item SPV.0060.508.

A Description

This special provision describes furnishing and planting plants of the species, varieties and sizes specified, complete in place at the locations as indicated on the plans.

B Materials

Follow City of Madison standard spec 209.2 and 209.3.

C Construction

Follow standard City of Madison standard specs 209.4, 209.5 and 209.6, and standard detail drawings 2.01, 2.02, 2.03, 2.04.and 2.05.

D Measurement

The City of Madison will measure by the number of plants of each species, variety and size complete in place, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.504.01	Trees (Early Glow Buckeye, B&B, 2-IN)	EACH
SPV.0060.504.02	Trees (Autumn Blaze Freeman Maple, B&B, 2-IN)	EACH
SPV.0060.504.03	Trees (State Street Miyabe Maple, B&B, 2-IN)	EACH
SPV.0060.504.04	Trees (Hackberry, B&B, 2-IN)	EACH
SPV.0060.504.05	Trees (Kentucky Coffee Tree, B&B, 2-IN)	EACH
SPV.0060.504.06	Trees (Skyline Thornless Honey Locust, B&B, 2-IN)	EACH
SPV.0060.504.07	Trees (Exclamation London Planetree, B&B, 2-IN)	EACH
SPV.0060.504.08	Trees (Swamp White Oak, B&B, 2-IN)	EACH
SPV.0060.504.09	Trees (Chinquapin Oak, B&B, 2-IN)	EACH
SPV.0060.504.11	Trees (American Sentry Linden, B&B, 2-IN)	EACH
SPV.0060.504.13	Trees (Princeton Elm, B&B, 2-IN)	EACH
SPV.0060.504.14	Trees (New Horizon Elm, B&B, 2-IN)	EACH
SPV.0060.504.15	Trees ('Autumn Brilliance' Apple Serviceberry, B&B, 2-IN)	EACH
SPV.0060.504.16	Trees (Flowering Crabapple, B&B, 2-IN)	EACH

SPV.0060.504.17	Trees (Prairie Fire Crabapple, B&B, 2-IN)	EACH
SPV.0060.504.18	Trees (Japanese Tree Lilac, B&B, 2-IN)	EACH
SPV.0060.506.01	Shrubs (Arctic Fire Red-Osier Dogwood, Potted, 1 GAL)	EACH
SPV.0060.506.02	Shrubs (Sea Green Juniper, Potted, 1 GAL)	EACH
SPV.0060.506.03	Shrubs (June Grass, Potted, 1 GAL)	EACH
SPV.0060.506.04	Shrubs (Creeping Siberian Cypress, Potted, 1 GAL)	EACH
SPV.0060.506.05	Shrubs (Calamint, Potted, 1 GAL)	EACH
SPV.0060.506.06	Shrubs (Gro-Low Fragrant Sumac, Potted, 1 GAL)	EACH
SPV.0060.507.01	Perennials & Native Grasses (Butterfly Milkweed, Potted, 1 GAL)	EACH
SPV.0060.507.02	Perennials & Native Grasses (Sand Coreopsis, Potted, 1 GAL)	EACH
SPV.0060.507.03	Perennials & Native Grasses (Purple Prairie Clover, Potted, 1 GAL)	EACH
SPV.0060.507.04	Perennials & Native Grasses (Purple Coneflower, Potted, 1 GAL)	EACH
SPV.0060.507.05	Perennials & Native Grasses (Blazing Star, Potted, 1 GAL)	EACH
SPV.0060.507.06	Perennials & Native Grasses (Dwarf Fountain Grass, Potted, 1 GAL)	EACH
SPV.0060.507.07	Perennials & Native Grasses (Blue False Indigo, Potted, 1 GAL)	EACH
SPV.0060.507.08	Perennials & Native Grasses (Black-eyed Susan, Potted, 1 GAL)	EACH
SPV.0060.507.09	Perennials & Native Grasses (Little Bluestem, Potted, 1 GAL)	EACH
SPV.0060.507.10	Perennials & Native Grasses (Autumn Joy Sedum, Potted, 1 GAL)	EACH
SPV.0060.507.11	Perennials & Native Grasses (Prairie Dropseed, Potted, 1 GAL)	EACH
SPV.0060.507.12	Perennials & Native Grasses (Canada Anemone, Potted, 1 GAL)	EACH
SPV.0060.507.13	Perennials & Native Grasses (Sky Blue Aster, Potted, 1 GAL)	EACH
SPV.0060.507.14	Perennials & Native Grasses (Prairie Smoke, Potted, 1 GAL)	EACH
SPV.0060.507.15	Perennials & Native Grasses (June Grass, Potted, 1 GAL)	EACH
SPV.0060.507.16	Perennials & Native Grasses (Jacob's Ladder, Potted, 1 GAL)	EACH
SPV.0060.508	Plug Mix	EACH

Payment includes the number of plants, furnished and planted, at the contract unit price each for Trees (Species, Root, Size), Shrubs (Species, Root, Size), Perennials/Grasses (Species, Root, Size), and Plugs, as the case may be, which price shall be payment in full for furnishing, transporting, handling, potting, storing, pruning, placing and replacing plant materials; for all excavation of plant holes, salvaging of topsoil, mixing and backfilling, and planting soil; for furnishing and applying all required fertilizer, mulch, water, wrapping, guys and braces, rodent protection, herbicides and anti-dessicant spray; for removing guys and braces; for disposal of all excess and waste materials; for care; and for furnishing all labor, tools, equipment and incidentals necessary to complete the work.

17-6 Tree Trimming, Item SPV.0060.505.

A Description

This special provision describes the trimming of trees at locations as indicated on the plans. All tree trimming shall be coordinated with City Forester, including inspection of tree protection measures.

B (Vacant)

C Construction

Trim branches and other material overhanging the proposed station and sidewalk as the plans designate to the limits indicated by the City Forester, and in accordance with standard spec 202.

D Measurement

The City of Madison will measure Tree Trimming as each individual tree acceptably trimmed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0060.505	Tree Trimming	EACH

Payment includes all equipment, labor and materials necessary to complete this item as specified.

17-7 Seeding, Item SPV.0085.501; Stormwater Management Seeding, SPV.0085.502.

A Description

This special provision describes preparing seed beds, furnishing and sowing the required seed, furnishing and applying the required stabilizers, fertilizer, and mulching material at the locations as indicated on the plans.

B Materials

B.1 Seeding at Station Areas along the BRT Corridor and Western Terminal Park & Ride

Use Sun Terrace Seed Mix in accordance with City of Madison standard spec 207.2.

B.2 Seeding at Western Terminal Stormwater Management Area

Use seed mixes as indicated on Western Terminal seed list on the plan.

C Construction

C.1 Seeding at Station Areas along the BRT Corridor and Western Terminal Park & Ride

Follow City of Madison standard spec 207.3 and 207.4.

C.2 Seeding at Western Terminal Stormwater Management Area

Follow WisDOT standard spec 630.

D Measurement

The City of Madison will measure by the square yard, acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0085.501	Seeding	LB
SPV.0085.502	Stormwater Management Seeding	LB

Payment includes full compensation for furnishing, handling, and storing all seed; for preparing the seed bed and sowing the seed; for furnishing, hauling, handling, storing, placing, and incorporating the fertilizer into the work; for furnishing, hauling and placing soil stabilizers; for furnishing, hauling, treating, placing, spreading, and anchoring of the mulch material unless the area is to receive erosion matting, in which case mulch is not required; for maintenance of the work and the repair of all damaged areas; and for furnishing all labor, tools, equipment, and incidentals necessary to complete this item as specified.

17-8 Granite Planter Edge Remove and Salvage, Item SPV.0090.501.

A Description

This special provision describes removing and salvaging existing granite edging of existing planter boxes.

B (Vacant)

C Construction

Deliver all salvaged granite pieces to Goodman Maintenance Facility at 1402 Wingra Creek Parkway, Madison, WI 53715.

D Measurement

The City of Madison will measure Granite Planter Edge Remove and Salvage by the linear foot acceptably completed.

E Payment

The City of Madison will pay for measured quantities at the contract unit price under the following bid item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0090.501	Granite Planter Edge Remove and Salvage	LF

Payment is full compensation for all materials, labor and incidentals for removing and salvaging the granite pieces, and delivery to the Goodman Maintenance Facility in accordance with the drawings and as set forth in these specifications.

ARCHITECTURAL SPECIAL PROVISIONS
Package 1

Madison Bus Rapid Transit

STATION SHELTERS

Final PS&E

ISSUE DATE:
October 5, 2022

ARCHITECTURAL SPECIAL PROVISIONS, PACKAGE 1, TABLE OF CONTENTS

DIVISIONS 27 – 31

Not Applicable

DIVISION 32 – EXTERIOR IMPROVEMENTS

DIVISIONS 33 – 49

Not Applicable

END TABLE OF CONTENTS

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.

B. Execute accepted alternates under the same conditions as other Work of the Contract.

C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: Photovoltaic Array.

1. Base Bid: Provide shelters as shown on Drawings and described in Specifications. Infrastructure for solar panels shall include data ports, conduit connections through roof feature, connections to electrical panels, dedicated circuit in panels, and a PV array disconnect. Refer to Drawings and Specifications for more information.
2. Alternate: Provide minimum of four (4) 60-cell PV array panels at each of the BRT Stations listed on Drawing Sheet O-5. Include micro inverters and ballasted racking. Refer to Specification 263100 Photovoltaic Collectors.

B. Alternate No. 2: Snow Melt.
   1. Base Bid: No Work.
   2. Alternate: Provide snow melt system as described in the Special Provisions Article 11-7.

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form that is part of web-based Project management software or acceptable to Architect.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.

f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within five days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect

will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. RFIs.
   4. Digital project management procedures.
   5. Web-based Project management software package.
   6. Project meetings.

B. Related Requirements:
   1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.

15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
   1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow four days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI number, including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
   1. Web-based Project management software includes, at a minimum, the following features:
      a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.

b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Architect, and Architect's consultants.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of four days prior to meeting. Provide meeting location or virtual meeting weblinks.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these

meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of Proposal Requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittal schedule requirements.
   2. Administrative and procedural requirements for submittals.

B. Related Requirements:
   1. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
   2. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following information in a tabular format:
      a. Scheduled date for first submittal.

b. Specification Section number and title.
c. Submittal Category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled dates for purchasing.
h. Scheduled date of fabrication.
i. Scheduled dates for installation.
j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:
1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:
1. Paper Submittals are permitted for physical samples only.
2. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
3. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
4. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

5. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using transmittal form as approved by Architect.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
a. If web-based project management software is not used:
b. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
2. Paper: Prepare submittals in paper form and deliver to Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams that show factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
   1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
   2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
      a. Project name and submittal number.
      b. Generic description of Sample.
      c. Product name and name of manufacturer.
      d. Sample source.
      e. Number and title of applicable Specification Section.
      f. Specification paragraph number and generic name of each item.
   3. Samples shall be submitted in both digitally and physical submittals as follows:
      a. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
      b. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
      c. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
   4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
      a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
      b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
   5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
      a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
   6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
      a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned.
         1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
         2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:
   1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
   2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
   3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
   4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
   5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
   6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:
   1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
   2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
   3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
   4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed

before installation of product, for compliance with performance requirements in the Contract Documents.

5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
    1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
    1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
    1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
   1. Digital Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
      a. Conforms As Is: Where submittals are marked "Conforms As Is," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
      b. Conforms As Noted: When submittals are marked "Confirms As Noted," that part of the Work covered by the submittal may proceed provided it complies with both the Architect's notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
      c. When submittal is marked "Does Not Conform;" or "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise and prepare a new submittal in accordance with the Architect's notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals marked as indicated above to be used at the Project site, or elsewhere where construction is in progress.
   2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
      a. Conforms As Is: Where submittals are marked "Conforms As Is," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
      b. Conforms As Noted: When submittals are marked "Confirms As Noted," that part of the Work covered by the submittal may proceed provided it complies with both the Architect's notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
      c. When submittal is marked "Does Not Conform;" or "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise and prepare a new submittal in accordance with the Architect's notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals marked as indicated above to be used at the Project site, or elsewhere where construction is in progress.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency

qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Contractor's quality-control personnel.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports and documents as specified.

F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, telephone number, and email address of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement of whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, telephone number, and email address of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement of whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
   1. Provide test specimens representative of proposed products and construction.
   2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   3. Provide sizes and configurations of test assemblies to adequately demonstrate capability of products to comply with performance requirements.
   4. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Engage a qualified testing agency to perform quality-control services.
   a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
   3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
   1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that

does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
   1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
   2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
   2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
      a. Name of product and manufacturer.
      b. Model and serial number.
      c. Capacity.
      d. Speed.
      e. Ratings.
   3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:
   1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
   2. Store products to allow for inspection and measurement of quantity or counting of units.
   3. Store materials in a manner that will not endanger Project structure.
   4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
   5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   7. Protect stored products from damage and liquids from freezing.
   8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
   a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following

conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
   1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
   2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
   1. Construction layout.
   2. Installation of the Work.
   3. Cutting and patching.
   4. Progress cleaning.
   5. Starting and adjusting.
   6. Protection of installed construction.
   7. Correction of the Work.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 QUALITY ASSURANCE

A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
   4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner

that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb, and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Remove waste materials at the end of each day.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.
   4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with City’s waste disposal requirements.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
      a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
   4. Submit testing, adjusting, and balancing records.
   5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Complete startup and testing of systems and equipment.
   2. Perform preventive maintenance on equipment used prior to Substantial Completion.
   3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
   4. Terminate and remove temporary facilities from Project site, along with construction tools and similar elements.
   5. Complete final cleaning requirements.
   6. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
   1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed

and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
2. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.
3. Submit list of incomplete items in one of the following formats:
   a. MS Excel Electronic File: Architect will return annotated file.
   b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect or by uploading to web-based project software site.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
      a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Remove snow and ice to provide safe access.
      f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces.
      g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      h. Clean transparent materials, including glass. Remove glazing compounds and other noticeable, vision-obscuring materials.
      i. Remove labels that are not permanent.
      j. Wipe surfaces of electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
      k. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
      l. Clean strainers.
      m. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

1.2 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Form ties.
4. Form-release agent.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED MATERIALS

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

D. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

E. Do not use rust-stained, steel, form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips.
2. Use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

J. Form openings, chases, offsets, sinkages, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

K. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.

L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Clean embedded items immediately prior to concrete placement.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars:

1. Steel Bars: ASTM A615, Grade 60, deformed bars.
2. Epoxy Coating: ASTM A775 with less than 2 percent damaged coating in each 12-inch bar length.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced.

C. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Stagger splices in accordance with ACI 318.
2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

    a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
6. Curing materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.

3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
9. Intended placement method.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Bonding agents.
5. Adhesives.
6. Joint-filler strips.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures.

C. Preconstruction Test Reports: For each mix design.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.6 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F: Black.
b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
c. Ambient Temperature Above 85 deg F: White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

F. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.4 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.5 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Total of Fly Ash or Other Pozzolans, and Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.6 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, foundation walls, and platforms.

1. Exposure Class: ACI 318 F3.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.

B. Class B: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of slabs.
3. Unless otherwise indicated on Drawings, locate vertical joints in walls near corners, and in concealed locations where possible.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as foundation walls and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement and embedded items is complete and that required inspections are completed.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. Deposit concrete to avoid segregation.
2. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
3. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete slabs in a checkerboard sequence.

2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view.

B. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Perform abrasive blasting after compressive strength of concrete exceeds 2000 psi (13.8 MPa).
2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
3. Surface Continuity:

    a. Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.

4. Abrasive Blasting:

    a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
    b. Determine type of nozzle pressure and blasting techniques required to match field sample.

c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:

1) Light Texture: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color, with maximum reveal of 1/16 inch (1.5 mm).

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

a. Slabs on Ground:

1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.9 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces.
2. If forms remain during curing period, moist cure after loosening forms.
3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Curing Compound:

        1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
        2) Recoat areas subjected to heavy rainfall within three hours after initial application.
        3) Maintain continuity of coating, and repair damage during curing period.
        4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

    a. Limit cut depth to 3/4 inch.
    b. Make edges of cuts perpendicular to concrete surface.
    c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    d. Fill and compact with patching mortar before bonding agent has dried.
    e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to remain exposed with repair topping.

    a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

    a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    d. Place, compact, and finish to blend with adjacent finished concrete.
    e. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports to include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.
5. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143:

    a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231 pressure method, for normal-weight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31:
    a. Cast, initial cure, and field cure four standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.
    a. Test one field-cured specimen at seven days and one set of two specimens at 28 days.
    b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive strength test value is less than 90 percent of specified compressive strength.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests:

a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.

1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.13 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 099600 “High Performance Coatings.”

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Forged-steel hardware.
6. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Connection designs have been completed and connections indicated on the Drawings.

C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992.

B. Channels, Angles, S-Shapes: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B structural tubing.

E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Nuts: ASTM A563 hex carbon steel.
2. Plate Washers: ASTM A36 carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

2.5 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

END OF SECTION 051200

SECTION 051213 - ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Architecturally exposed structural steel (AESS).
   2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:
   1. Section 099600 "High-Performance Coatings" for surface preparation and priming requirements.

1.2 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

B. Category AESS 2: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 2 and is designated as AESS 2 or Category AESS 2 in the Contract Documents.

C. Category AESS 3: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 3 and is designated as AESS 3 or Category AESS 3in the Contract Documents.

D. SEAC/RMSCA Guide Specification: SEAC/RMSCA's "Sample Specification, Section 05 02 13: Architecturally Exposed Structural Steel."

1.3 COORDINATION

A. Coordinate surface preparation requirements for shop-primed items.

B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data:
   1. Tension-control, high-strength, bolt-nut-washer assemblies.
   2. Corrosion-resisting (weathering steel), tension-control, high-strength, bolt-nut-washer assemblies.

3. Filler.
4. Primer.
5. Etching cleaner.
6. Galvanized repair paint.

B. Shop Drawings: Show fabrication of AESS components.
1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment Drawings.
4. Indicate orientation of mill marks and HSS seams.
5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
7. Indicate exposed surfaces and edges and surface preparation being used.
8. Indicate special tolerances and erection requirements.
9. Indicate weep holes for HSS and vent holes for galvanized HSS.
10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and shop-painting applicator.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category CSE, and is experienced in erecting AESS similar to that indicated on this Project.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P3 or SSPC-QP 3.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.
   1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.9 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, (ASTMA563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
   1. Finish: Mechanically deposited zinc coating.

B. Corrosion-Resisting (Weathering) Steel, Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 3, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 3, hardened carbon-steel washers.

2.3 FILLER

A. Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

A. Steel Primer:
   1. Comply with Section 099600 "High-Performance Coatings."

2.5 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.
   1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

B. Category AESS 2: Where shown on Drawings including portions or the columns and crossbars above the roof.
   1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
   2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
   3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
   4. Make intermittent welds appear continuous, using filler or additional welding.
   5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
   6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
   7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
   8. Remove weld spatter, slivers, and similar surface discontinuities.
   9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
   10. Grind tack welds smooth unless incorporated into final welds.
   11. Remove backing and runoff tabs, and grind welds smooth.
   12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
   13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
   14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
   15. Conceal fabrication and erection markings from view in the completed structure.
   16. Make welds uniform and smooth.

C. Category AESS 3: Where shown on Drawings, including columns below the roof and the exposed roof edge steel tube sections.
   1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
   2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
   3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
   4. Make intermittent welds appear continuous, using filler or additional welding.
   5. Seal weld open ends of hollow structural sections with 3/8-inch (9.5-mm) closure plates.
   6. Limit butt and plug weld projections to 1/16 inch (1.6 mm).
   7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
   8. Remove weld spatter, slivers, and similar surface discontinuities.

9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.
17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by Architect.
18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
19. Orient HSS seams as indicated or away from view.
20. Align and match abutting member cross sections.
21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch (3.2 mm). At closed joints, maintain uniform contact within 1/16 inch (1.6 mm).
22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by Architect.

D. Erection marks, painted marks, and other marks are permitted on galvanized- steel surfaces of completed structure.

E. Cleaning Corrosion-Resisting (Weathering) AESS: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6 (WAB)/NACE WAB-3.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123/A123M.
   1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
   2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

2.8 SHOP PRIMING

A. Shop prime steel surfaces, except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.

B. Preparing Galvanized Steel for Shop Priming: After galvanizing, thoroughly clean steel of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner or according to SSPC-SP 16.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and eased edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.
   1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
   2. Grind tack welds smooth.

3. Remove backing and runoff tabs, and grind welds smooth.
4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
5. Conceal fabrication and erection markings from view in the completed structure.

B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.
1. Erection of Category AESS 2:
a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
c. Remove weld spatter, slivers, and similar surface discontinuities.
d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
e. Continuous welds are to be of uniform size and profile.
f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
g. Splice members only where indicated on Drawings.
h. No torch cutting or field fabrication is permitted.
2. Erection of Category AESS 3:
a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
c. Remove weld spatter, slivers, and similar surface discontinuities.
d. Grind off butt and plug weld projections larger than 1/16 inch (1.6 mm).
e. Continuous welds are to be of uniform size and profile.
f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
g. Splice members only where indicated on Drawings.
h. No torch cutting or field fabrication is permitted.
i. Weld profiles, quality, and finish are be as approved by Architect.
j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.5 REPAIR

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and touchup galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:
   1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting, to comply with SSPC-PA 1 for touching up shop-painted surfaces.
      a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
   2. Cleaning and touchup painting are specified in Section 099600 "High-Performance Coatings."

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.

END OF SECTION 051213

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Product Certificates: For each type of steel deck.

B. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33 zinc coating.

2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

2.3 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

I. Galvanizing Repair Paint: ASTM A780.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI RD; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.2 INSTALLATION OF ROOF DECK

A. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

C. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

D. Miscellaneous Roof-Deck Accessories: Install finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

3.3 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780 and manufacturer's written instructions.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall and soffit framing.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Cold-formed steel framing materials.
   2. Exterior non-load-bearing wall and soffit framing.
   3. Power-actuated anchors.

B. Shop Drawings:

   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1, "Structural Welding Code - Steel."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S200 and ASTM C955, Section 8.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with AISI S200 and ASTM C955, Section 8 for conditions indicated.

B. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST50H.
2. Coating: G90 or equivalent.

2.3 EXTERIOR NON-LOAD-BEARING WALL AND SOFFIT FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: 1-5/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.2 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL AND SOFFIT FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Install horizontal bridging in walls and soffits, spaced as indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

E. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall or soffit framing system.

3.3 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error is not to exceed minimum fastening requirements of sheathing or other finishing materials.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Miscellaneous framing and supports.
   2. Abrasive metal nosings

B. Related Requirements:
   1. Section 051200 "Structural Steel Framing" for steel framing, supports, and other steel items attached to the structural-steel framing.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Fasteners.
   2. Shop primers.
   3. Abrasive metal nosings.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated Design Submittals: For metal fabrications, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

C. Research Reports: For post-installed anchors.

D. Delegated design engineer qualifications.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal fabrications

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 6061-T6.

F. Aluminum Extrusions: ASTM B221 (ASTM B221M), Alloy 6063-T6.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A (ISO 898-1, Property Class 4.6); with hex nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325 (Grade A325M), Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, (ASTM A563M, Class 10S3) heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593 (ISO 3506-1); with hex nuts, ASTM F594 (ASTM F836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563 (ASTM A563M); and, where indicated, flat washers.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with primer specified in Section 099600 "High-Performance Coatings" where indicated.

2.7 ABRASIVE METAL NOSINGS

A. Extruded Units: Aluminum, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Balco; a CSW Industrials Company; T-Series or a comparable product by one of the following:
   a. American Safety Tread Co., Inc.
   b. Nystrom, Inc.
   c. Wooster Products Inc.
2. Source Limitations: Obtain units from single source from single manufacturer.
3. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
4. Nosings:
   a. Square-back units, width as indicated on Drawings, for casting into concrete steps.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply clear lacquer to concealed surfaces of extruded units.

2.8 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.9 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with primers specified in Section 099600 "High-Performance Coatings" are indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.

4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for signage and other ceiling-mounted equipment securely to, and rigidly brace from, building structure.

3.3 INSTALLATION OF ABRASIVE METAL NOSINGS

A. Center nosings on tread widths unless otherwise indicated.

B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

3.4 REPAIRS

A. Touchup Painting:
1. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099600 "High-Performance Coatings."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stainless steel railings.

1.2 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: Each product type.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.

D. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
   1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 STAINLESS STEEL RAILINGS

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Tubing: ASTM A554, Grade MT 316L.

C. Pipe: ASTM A312/A312M, Grade TP 316L.

D. Castings: ASTM A743/A743M, Grade CF 8M or CF 3M.

E. Plate and Sheet: ASTM A240/A240M or ASTM A666, Type 316L.

2.4 FASTENERS

A. Fastener Materials:
   1. Stainless Steel Railing Components: Type 316 stainless steel fasteners.
   2. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
   1. For stainless steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
   1. Water-Resistant Product: Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
   1. Clearly mark units for reassembly and coordinated installation.
   2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.
   1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
   2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.
   1. Provide weep holes where water may accumulate.
   2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay.

I. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.

K. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
   1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
   2. Coordinate anchorage devices with supporting structure.

L. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

2.7 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run grain with long dimension of each piece.
   2. When polishing is completed, passivate and rinse surfaces.
   3. Remove embedded foreign matter and leave surfaces chemically clean.

C. Stainless Steel Pipe and Tubing Finishes:
   1. 180-Grit Polished Finish: Uniform, directionally textured finish.

D. Stainless Steel Sheet and Plate Finishes:
   1. Directional Satin Finish: ASTM A480/A480, No. 4.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.
   1. Fit exposed connections together to form tight, hairline joints.
   2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
   3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
   4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   5. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
   6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (6 mm in 3.5 m).

B. Adjust railings before anchoring to ensure matching alignment at abutting joints.

C. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches (50 mm) beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

3.4 CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

3.5 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood products.
   2. Wood-preservative-treated lumber.

B. Related Requirements:
   1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:
   1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
   3. Dress lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:
   1. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include the following items:
      a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   3. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2.4 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
   2. ICC-ES evaluation report for fastener.

I. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Parapet sheathing.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood blocking.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Parapet sheathing.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

C. Shop Drawings:
   1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Wood-preservative-treated plywood.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC3b for exterior construction not in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 PARAPET SHEATHING

A. Plywood Sheathing, Parapets: DOC PS 1, Exterior, Structural I sheathing.
   1. Nominal Thickness: Not less than 1/2 inch (13 mm).

B. Oriented-Strand-Board Sheathing, Parapets: DOC PS 2, Exposure 1, Structural I sheathing.
   1. Nominal Thickness: Not less than 1/2 inch (13 mm).

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
   2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

END OF SECTION 061600

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concealed-fastener, lap-seam metal wall panels.

1.2 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
   1. Concealed-fastener, lap-seam metal wall panels.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
   1. Include Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:
   1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For concealed-fastener, lap-seam metal wall panels, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:
   1. Wind Loads: As indicated on Drawings.
   2. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company; Flush wall panels. or a comparable product by one of the following:
      a. AEP Span a brand of ASC Profiles LLC, a part of BlueScope.
      b. ATAS International, Inc.
      c. Berridge Manufacturing Company.
      d. CENTRIA, a Nucor Brand.
   2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
      a. Nominal Thickness: 24 gauge.
      b. Exterior Finish: Two-coat fluoropolymer.
      c. Color: Match RAL 9011 Graphite Black.
   3. Panel Coverage: 12 inches (305 mm).
   4. Panel Height: 1.0 inch (25 mm).

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
   1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
   1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
   2. Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
   3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:
1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving metal panels.
   2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Install flashing and trim as metal panel work proceeds.
   6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
   1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.13

SECTION 074243 - COMPOSITE WALL AND SOFFIT PANELS

1.1 SUMMARY

A. Sections includes phenolic wall and soffit cladding panels, attachment systems, and fasteners.

B. Related Requirements:
   1. Section 084313 “Aluminum-Framed Storefronts” for composite panels installed in the storefront framing system.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:
   1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
   2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Panels: 12 inches (305 mm) long by actual panel width. Include fasteners, closures, and other panel accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: All products listed in this section are to be installed by a single installer recommended by the manufacturer or representative.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling.

B. Unload, store, and erect panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store panels to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

A. Coordinate panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Manufacturer to warrant against material defects and manufacturing tolerances for a period of 10-years.

B. Installer to warrant against installation defects for a period of 2-years. Repair or replace materials during warranty period at no cost to Owner.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: ASTM E1592.
1. Wind Loads: As indicated on Drawings.

B. Air Infiltration: ASTM E283.

C. Water Penetration: ASTM E331.

2.2 WALL AND SOFFIT PANELS

A. Basis-of-Design Product: Subject to compliance with the requirements, provide Fiberesin Industries, Stonewood Stack Panels or comparable product by manufacturer approved by Architect and meeting the Buy America provisions.
   1. Source limitations: Obtain all phenolic paneling from a single manufacturer including paneling used in storefront system and specified in Section 084313 “Aluminum-Framed Storefronts.”

B. Phenolic Exterior Wall Cladding: Solid phenolic laminate panel with UV protective clear coat.
   1. Style: Stonewood Concealed Fastener system.
   2. Color: Madison Walnut
   3. Install Pattern: As shown on Drawings
   4. Finish: Factory #60 matte
   5. Thickness: 3/8 inch (10mm)
   6. Plank width: 8-inches.
   7. Panel Core: Phenolic resin treated layer, black and natural brown kraft paper.
   8. Decorative Layer: Melamine resin, proprietary pigmented and treated.
   9. Weather and UV Resistant Layer: 2-mil, proprietary layer combining pigment protection, Ultraviolet light and weather resistant layer.
   10. Physical Properties
      a. Flexural Strength, ASTM D790
         1) Machine Direction: 19,000 psi
         2) Cross Direction: 16,000 psi
      b. Flexural Modulus, ASTM D790
         1) Machine Direction: 1,300,000 psi
         2) Cross Direction: 1,000,000 psi
      c. Tensile Modulus, ASTM D638
         1) Machine Direction: 14,000 psi
         2) Cross Direction: 10,000 psi
      d. Structural Performance: Withstand design wind load based on building code, but not less than 23psf with maximum L/180 tested to ASTM E330.
      e. Fire Performance:
         1) Flame Spread/Smoke Developed: Class A tested to ASTM E84
         2) Ignition Temperature: Greater than 650 degrees F (350 degrees C) above ambient, tested to ASTM D1929.
         3) Extended Surface Burn: Max Flame Front less than 10 feet, tested to ASTM E2768
      f. Finish Performance:
         1) Humidity Resistance: No cracking, checking, crazing, erosion, delamination, distress, tested to ASTM D2247.
         2) Salt Spray Resistance: No cracking, checking, crazing, Erosion, Delamination, or distress, tested to ASTM B117.
         3) Weather Exposure: Maximum gray scale change of 3-4 according to DIN EN 438-2 29 when tested to ASTM D2244 at accelerated – 3000 Hours in Atlas Type Weatherometer using cycle of 102 minutes light and 18 minutes diminished light and demineralized water.

C. Mounting System:
   1. Manufacturer’s concealed fastening on aluminum rail over metal sub framing.

D. Metal Sub-structure: Aluminum sub-structure designed to withstand structural loading due to wind load and the dead load of the panel, painted as required to conceal behind the open joint of the attachment system.
   1. Extrusions, including corner closures, joint closures and vent screens, formed members, sheet, and plate shall conform with the recommendations of the manufacturer.

2.3 FABRICATION

A. Panels: Solid High-Pressure Laminate impregnated kraft paper wall panels with no voids, air spaces or foamed insulation in the core material.

B. Panel Dimensions: Field fabrication shall be allowed where necessary but, shall be kept to an absolute minimum. All fabrication shall be done under controlled shop conditions when possible.

C. Accessory items in accordance with manufacturer's recommendations and approved submittals.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine materials, installation instructions, and review manufacturer’s instructions on site.

B. Verify panel style, color, and fasteners are approved by Architect.

C. Verify substrates and adjacent surfaces are level and plumb for installation.
   1. Do not begin work until construction has progressed to allow installation of materials.
   2. Confirm sheathing is plumb and level, with no deflection greater than 1/4- inch in 20 feet.
   3. Verify manufacturers fastener spacing requirements.
   4. Verify proper hole diameter in panels per manufacturer’s instructions.

D. Proceed with work when construction has progressed to allow a warranted installation.
   1. Installation deems acceptance of work for a warranted installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions and Shop Drawings, maintaining required 1-inch ventilation spacing requirement.

B. Fasten panels to an approved attachment system structurally supported by aluminum, galvanized steel or wood stud supported wall.

C. Install panel square, edges clean and true to size.
   1. Cut panels to fit at perimeter and around penetrations with minimum 3/8-inch gap.
   2. Re-chamfer field cut edges.

D. Do not install damaged, irregular or defective panels.

3.3 FIELD QUALITY CONTROL

A. Comply with manufacturer's written installation instructions applicable to products and applications indicated.

B. Verify installation, fasteners and connections with adjacent materials, and transitions have been completed in accordance with shop drawings.

C. Installer is responsible for engineering the connection between the Stonewood system and the supporting structure.

3.4 ADJUSTING

A. Modify, adjust and replace panels not within manufacturer's tolerances and as required by Architect.

3.5 PROTECTION

A. Protect surface, corners and components from damage prior to Substantial Completion.

END OF SECTION 074243

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Roof insulation.
5. Insulation accessories.

B. Related Requirements:
1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Thermoplastic polyolefin (TPO) roofing system.
   2. Accessory roofing materials.
   3. Substrate board.
   4. Roof insulation.
   5. Insulation accessories.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
   1. Layout and thickness of insulation.
   2. Base flashings and membrane termination details.
   3. Flashing details at penetrations.
   4. Tapered insulation layout, thickness, and slopes.
   5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
   6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:
   1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
      a. Submit evidence of compliance with performance requirements.
   2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:
   1. Concrete internal relative humidity test reports.
   2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, substrate board, and other components of roofing system.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.
   1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
   2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
   1. Fire/Windstorm Classification: Class 1A-90.
   2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 SH.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; JM TPO or a comparable product by one of the following:
      a. Firestone Building Products.
      b. GAF.
   2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
   3. Thickness: 60 mils (1.5 mm), nominal.
   4. Exposed Face Color: White.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
   1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 60 mils (1.5 mm) thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARD

A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
   1. Thickness: 1/2 inch (13 mm) thick.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; ENRGY 3 or a comparable product by one of the following:
      a. Firestone Building Products.
      b. GAF.
   2. Compressive Strength: 20 psi (138 kPa).

C. Tapered Insulation: Provide factory-tapered insulation boards.
   1. Material: Match roof insulation.
   2. Minimum Thickness: 1/4 inch (6.35 mm).
   3. Slope:
      a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
      b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES AND COVER BOARD

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.
   1. At steel roof decks, install substrate board at right angle to flutes of deck.
      a. Locate end joints over crests of steel roof deck.
   2. Tightly butt substrate boards together.
   3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.
   5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
   6. Loosely lay substrate board over roof deck.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

3.7 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Low-slope roof sheet metal fabrications.

B. Related Requirements:
   1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
   3. Review requirements for insurance and certificates if applicable.
   4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Include identification of material, thickness, weight, and finish for each item and location in Project.
   3. Include details for forming, including profiles, shapes, seams, and dimensions.
   4. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   5. Include details of termination points and assemblies.
   6. Include details of special conditions.
   7. Include details of connections to adjoining work.
   8. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches (1:5).

B. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

C. Samples for Verification: For each type of exposed finish.
   1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
   1. For roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
   1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
   2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 (Class AZM150) coating

designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:
    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: Match RAL 9011 Graphite Black.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
2. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder:

1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.4 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

F. Do not use graphite pencils to mark metal surfaces.

2.5 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
2. Fabricate from the following materials:
a. Galvanized Steel: 0.028 inch (0.71 mm) thick.
b. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
   1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of joint.
   3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
   4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
   5. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
   6. Do not field cut sheet metal flashing and trim by torch.
   7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
   1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
   2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
   3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

3.3 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
   1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
   2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:
   1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.

2. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

3.4 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.5 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.6 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nonstaining silicone joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Joint sealants.
   2. Joint-sealant backing materials.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.3 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
   1. Joint-sealant location and designation.
   2. Manufacturer and product name.
   3. Type of substrate material.
   4. Proposed test.
   5. Number of samples required.

B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

E. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
   3. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
   4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
   6. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
   1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
   2. Conduct field tests for each kind of sealant and joint substrate.
   3. Notify Architect seven days in advance of dates and times when test joints will be erected.
   4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
   5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Sika Corporation - Building Components.
      c. The Dow Chemical Company.
      d. Tremco Incorporated.

2.4 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or type as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
      a. Extent of Testing: Test completed and cured sealant joints as follows:
         1) Perform 10 tests for the first 1000 ft. (300 m) of joint length for each kind of sealant and joint substrate.
         2) Perform one test for each 1000 ft. (300 m) of joint length thereafter or one test per each floor per elevation.
      b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

c. Inspect tested joints and report on the following:
   1) Whether sealants filled joint cavities and are free of voids.
   2) Whether sealant dimensions and configurations comply with specified requirements.
   3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces.
   1. Joint Locations:
      a. Joints between metal panels.
      b. Perimeter joints between materials listed above and frames of storefront.
      c. Control and expansion joints in overhead surfaces.

d. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 084313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum-framed storefront systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
   2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed storefronts, showing the following:
      a. Joinery, including concealed welds.
      b. Anchorage.
      c. Expansion provisions.
      d. Glazing.
      e. Flashing and drainage.
   3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data:
   1. For Installer.

B. Product Test Reports: For aluminum-framed storefronts, for tests performed by a qualified testing agency.

C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

D. Sample Warranties: For special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed storefronts to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.
   2. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tubelite Inc.; 4500 Series or a comparable product by one of the following:
   1. EFCO Corporation.
   2. Kawneer Company, Inc.; Arconic Corporation.
   3. Wausau Window and Wall Systems.

B. Source Limitations: Obtain all components of aluminum-framed storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
   2. Failure also includes the following:
      a. Thermal stresses transferring to building structure.
      b. Glass breakage.
      c. Noise or vibration created by wind and thermal and structural movements.
      d. Loosening or weakening of fasteners, attachments, and other components.
      e. Failure of operating units.

B. Structural Loads:
   1. Wind Loads: As indicated on Drawings.

C. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m).
   2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

D. Structural: Test in accordance with ASTM E330/E330M as follows:
   1. When tested at positive and negative wind-load design pressures, storefront assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.

F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
   2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

2.3 ALUMINUM-FRAMED STOREFRONT SYSTEMS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Exterior Framing Construction: Nonthermal.
      a. System dimensions: 1-3/4 inches x 4-1/2 inches.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Center.
   4. Finish: High-performance organic finish.
   5. Fabrication Method: Field-fabricated stick system.
   6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   7. Steel Reinforcement: As required by manufacturer.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Phenolic Exterior Wall Cladding: Solid phenolic laminate panel with UV protective clear coat.
   1. Basis-of-Design Product: Subject to compliance with the requirements, provide Fiberesin Industries, Stonewood Exterior Architectural Panels CF or comparable product by manufacturer approved by Architect and meeting the Buy America provisions.
      a. Source limitations: Obtain all phenolic paneling used in storefront system from same manufacturer as panels specified in Section 074243 “Composite Wall and Soffit Panels.”
   2. Style: Stonewood Concealed Fastener system.
   3. Color: Madison Walnut
   4. Finish: Factory #60 matte
   5. Thickness: 3/8 inch (10mm)
   6. Panel Core: Phenolic resin treated layer, black and natural brown kraft paper.

7. Decorative Layer: Melamine resin, proprietary pigmented and treated.
8. Weather and UV Resistant Layer: 2-mil, proprietary layer combining pigment protection, Ultraviolet light and weather resistant layer.
9. Physical Properties
    a. Flexural Strength, ASTM D790
        1) Machine Direction: 19,000 psi
        2) Cross Direction: 16,000 psi
    b. Flexural Modulus, ASTM D790
        1) Machine Direction: 1,300,000 psi
        2) Cross Direction: 1,000,000 psi
    c. Tensile Modulus, ASTM D638
        1) Machine Direction: 14,000 psi
        2) Cross Direction: 10,000 psi
    d. Structural Performance: Withstand design wind load based on building code, but not less than 23psf with maximum L/180 tested to ASTM E330.
    e. Fire Performance:
        1) Flame Spread/Smoke Developed: Class A tested to ASTM E84
        2) Ignition Temperature: Greater than 650 degrees F (350 degrees C) above ambient, tested to ASTM D1929.
        3) Extended Surface Burn: Max Flame Front less than 10 feet, tested to ASTM E2768
    f. Finish Performance:
        1) Humidity Resistance: No cracking, checking, crazing, erosion, delamination, distress, tested to ASTM D2247.
        2) Salt Spray Resistance: No cracking, checking, crazing, Erosion, Delamination, or distress, tested to ASTM B117.
        3) Weather Exposure: Maximum gray scale change of 3-4 according to DIN EN 438-2 29 when tested to ASTM D2244 at accelerated – 3000 Hours in Atlas Type Weatherometer using cycle of 102 minutes light and 18 minutes diminished light and demineralized water.

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

E. Rigid PVC Filler.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
   1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   2. Color and Gloss: Match RAL 9011 Graphite Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 ERECTION TOLERANCES

A. Install aluminum-framed storefronts to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
   2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
      c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
   4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION 084313

SECTION 086300 - METAL-FRAMED SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes skylights with metal framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal-framed skylights.

B. Shop Drawings: For metal-framed skylights.
   1. Include plans, elevations, sections, and attachment details.
   2. Indicate structural loadings and reactions to be transmitted to supporting curbs.
   3. Include details of provisions for assembly expansion and contraction and for draining moisture within the assembly to the exterior.
   4. Include full-size isometric details of each vertical-to-horizontal intersection of assembly, showing the following:
      a. Joinery including concealed welds.
      b. Anchorage.
      c. Expansion provisions.
      d. Glazing.
      e. Flashing and drainage.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Compatibility and Adhesion Test Reports: For structural-sealant-glazed skylights, test reports from sealant manufacturer indicating that joint sealants have been tested for each material that will come in contact with sealants.

C. Product Test Reports: For metal-framed skylights, for tests performed by a qualified testing agency.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal-framed skylights to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of metal-framed skylights required for this Project.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal framed skylights that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals and other materials beyond normal weathering.
      d. Adhesive or cohesive sealant failures.
      e. Water leakage.
   2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Loads: As indicated on Drawings.

B. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Glazing Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

C. Lateral Bracing of Framing Members: Compression flanges of flexural members are laterally braced by cross members with minimum depth equal to 50 percent of flexural member that is braced. Glazing does not provide lateral support.

D. Structural-Test Performance: Metal-framed skylights tested in accordance with ASTM E330, as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified deflection limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Water Penetration under Static Pressure: Metal-framed skylights that do not evidence water penetration through fixed glazing and framing areas when tested in accordance with ASTM E331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METAL-FRAMED SKYLIGHTS

A. Metal-Framed Skylights: Glazed skylight assemblies supported by aluminum framing.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Wasco Products Inc.; Velux America LLC; Pinnacle or a comparable product by one of the following:
a. CPI Daylighting, Inc.
b. Kawneer Company, Inc.; Arconic Corporation.
c. Kingspan Light + Air LLC.
d. OldCastle BuildingEnvelope (OBE).
e. Solar Innovations, Inc.

B. Aluminum Framing Systems: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

C. Aluminum: Alloy and temper as recommended in writing by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B209 (ASTM B209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
3. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
4. Structural Profiles: ASTM B308/B308M.

D. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning skylight components.

F. Fasteners and Accessories: Manufacturer's standard, corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. At pressure caps, use ASTM A193/A193M stainless steel screws.
2. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
3. Reinforce members as required to receive fastener threads.
4. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system or fabricated from Series 300 stainless steel.

G. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

H. Anchor Bolts: ASTM A307, Grade A, galvanized steel.

I. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A240/A240M of type recommended in writing by manufacturer.

J. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.030 inch (0.762 mm) thick.

K. Framing Sealants: As recommended in writing by manufacturer.

L. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 GLAZING

A. Glazing: As specified in Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric types.

D. Glazing Sealants: As recommended in writing by manufacturer**.**

2.4 FABRICATION

A. Where practical, fit and assemble metal-framed skylights in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Fabricate aluminum components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.

3. Internal guttering systems or other means to drain water passing joints and moisture migrating within skylight to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

C. Fabricate aluminum sill closures with weep holes and for installation as continuous component.

D. Reinforce aluminum components as required to receive fastener threads.

E. Factory-Glazed, Metal-Framed Skylights:
1. Factory install glazing to comply with requirements in Section 088000 "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.5 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.
1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: Match RAL 9011 Graphite Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions.
1. Do not install damaged components.
2. Fit joints between aluminum components to produce hairline joints free of burrs and distortion.
3. Rigidly secure nonmovement joints.
4. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
5. Seal joints watertight unless otherwise indicated.

B. Metal Protection: Where aluminum will contact dissimilar materials, protect against galvanic action by painting contact surfaces with protective coating or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

D. Install components to drain water passing joints, and moisture migrating within skylight to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Glazing: Install glazing as specified in Section 088000 "Glazing."

G. Erection Tolerances: Install metal-framed skylights to comply with the following maximum tolerances:
   1. Alignment: Limit offset from true alignment to 1/32 inch (0.8 mm) where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches (76 mm); otherwise, limit offset to 1/8 inch (3.2 mm).
   2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m) but no greater than 1/2 inch (13 mm) over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Water-Spray Test: Before installation of interior finishes has begun, skylights are tested in accordance with AAMA 501.2 and do not evidence water penetration.
   2. Water Penetration under Static Pressure: Before installation of interior finishes has begun, areas are tested in accordance with ASTM E1105.
      a. Water Penetration: None.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.4 CLEANING AND PROTECTION

A. Clean exposed surfaces immediately after installing skylights. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Protect skylights from contact with contaminating substances resulting from construction operations. If contaminating substances do contact skylight surfaces, remove contaminants immediately according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to maintain metal-framed skylight operating system.

END OF SECTION 086300

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Glass products.
2. Laminated glass.
3. Glazing sealants.
4. Miscellaneous glazing materials.

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review temporary protection requirements for glazing during and after installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturers of fabricated glass units, glass testing agency, and sealant testing agency.

B. Product Certificates: For glass.

C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F (4.4 deg C).

1.11 WARRANTY

A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:
   1. Design Wind Pressures: As indicated on Drawings.
      a. Wind Design Data: As indicated on Drawings.
   2. Design Snow Loads: As indicated on Drawings.
   3. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.
   4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

5. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. For laminated-glass lites, properties are based on products of construction indicated.
2. Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.

2.2 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Strength: Where fully tempered float glass is indicated, provide fully tempered float glass.

2.3 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.4 LAMINATED GLASS

A. Laminated Glass: ASTM C1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
1. Construction: Laminate glass with polyvinyl butyral interlayer (PVB) or ethylene vinyl acetate (EVA) to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

2.5 GLAZING SEALANTS

A. General:
   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

B. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
   1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
      a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- (3-mm-) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
   1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 LAMINATED GLASS SCHEDULE

A. Clear Laminated Glass with Patterned Interlayer, Type GL-1:
   1. Application: Storefront glazing.
   2. Construction: Two plies of clear, fully tempered float glass.
   3. Minimum Thickness of Each Glass Ply: 6 mm.
   4. Interlayer Type: Laminate glass with PVB interlayer or EVA interlayer to comply with interlayer manufacturer's written instructions.
   5. Interlayer Thickness: 0.060 inch (1.52 mm).
   6. Interlayer Color and Pattern: 1/8-inch white dots, 1/4-inch on center, providing 20% coverage equal to Viracon Threat Factor 41 glazing.

B. Clear Laminated Glass with Frosted Interlayer, Type GL-2: Laminated glass.
   1. Application: Skylight glazing.
   2. Construction: Two plies of clear, fully tempered float glass.
   3. Thickness of Each Glass Ply: 6 mm.
   4. Interlayer Type: Laminate glass with PVB interlayer or EVA interlayer to comply with interlayer manufacturer's written instructions.

5. Interlayer Thickness: 0.060 inch (1.52 mm).
6. Interlayer Color: White
7. Visible Light Transmittance of Interlayer: 40 percent minimum.

END OF SECTION 088000

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.4 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product listed in the Part 3 Coating Schedule or comparable product by one of the following:
   1. Steel Coatings:
      a. International Protective Coatings.
      b. PPG Paints; PPG Industries, Inc.
      c. Sherwin-Williams Company (The).
      d. Tnemec Company, Inc.
   2. Anti-Graffiti Coatings:
      a. Rainguard Pro.
      b. Sika Limited.
      c. Sherwin Williams
      d. Prosoco

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
   3. Products shall be of same manufacturer for each coat in a coating system.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

G. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for coating and substrate indicated.
   2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
   1. Contractor shall touch up and restore coated surfaces damaged by testing.
   2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 HIGH-PERFORMANCE COATING SCHEDULE

A. Concrete Substrates, Vertical Surfaces, Anti-Graffiti Coating:
   1. Surface Preparation: Surfaces shall be clean and dry with no oils, dirt, debris, or minerals such as efflorescence, lime and calcium
   2. Finish: 2 coats VandlGuard Non-Sacrificial Coating

B. Galvanized-Metal Substrates:
   1. Pigmented Polyurethane over Epoxy Primer System:
      a. Surface Preparation: In accordance with manufacturer's written instructions.
      b. Shop-Applied Prime Coat: 1 coat Sherwin Williams Macropoxy 646.
      c. Finish: 2 coats Sherwin Williams Acrolon 218HS.
         1) Color: Match RAL 9011 Graphite Black

END OF SECTION 099600

SECTION 108113 – BIRD CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes Bird Barrier Spikes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: In manufacturer's standard sizes with mounting hardware.

1.3 INFORMATIONAL SUBMITTALS

A. Installer Qualifications.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For bird barrier spikes, to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Experience with installations similar to this Work and approved by the manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver bird barrier spikes and mounting hardware to Project site in original, unopened packages. Do not stack or place other packaging or objects on shipping boxes.

B. Keep bird barrier spikes in original packing until needed for installation.

PART 2 - PRODUCTS

2.1 BIRD BARRIER SPIKES

A. Basis-of-Design Product: Subject to compliance with the requirements, provide Nixalite of America, Premium Nixalite H bird barrier spikes or comparable product by one of the following:
   1. Bird-B-Gone.

2. Bird-X.

B. Bird Barrier Spikes:
   1. Material: Stainless steel wire and base strip spikes
      a. Wires: Stainless steel, 0.041” (1 mm) diameter, full-hard spring temper.
      b. Base Strip: Stainless steel, 0.25” wide x 0.02” thick (6.3 mm x 0.5 mm), full anneal for flexibility, easy strip cutting and surface shape memory.
   2. Half row spike: 4-inch high (10.2 cm), 2-inch wide (5.1 cm), minimum 60 wire points per foot, 90 degree wire coverage.

C. Mounting Hardware:
   1. Material: Stainless steel or non-corrosive materials.
   2. Mounting Hardware must allow for bird spike strip installation, removal and reinstallation without damaging the installation surface, the spike strips or the mounting system.
   3. Hardware Requirements by surface type:
      a. Masonry, stone, concrete: Mounting clip, sheet metal screw, masonry anchor
      b. Wood, plywood, shingles: Mounting clip, sheet metal screw, washer
      c. Sheet metal, plastic, PVC: Mounting clip, sheet metal screw, washer
      d. Steel: Mounting clip, drive screw, washer
      e. Pipes, cables, conduit, grates: Wire tie, wire tying tool, adhesive
   4. Apply adhesive or sealant in all holes that penetrate the installation surface. After mounting hardware is installed, apply additional adhesive or sealant over the heads of the sheet metal screws and/or the drive screws. Do not get adhesive or sealant in the hook end of the mounting clips.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Visually inspect all installation surfaces. Make sure all surfaces are clean, dry and free from debris or other conditions that could impede the workflow of this section. All surfaces must be sanitized and deodorized before installation.

B. Notify architect of detrimental conditions. Do not proceed until these conditions have been corrected.

3.2 PREPARATION

A. Field Measurements: Verify the dimensions for each surface specified for installation. Use manufacturer’s planning guides to verify that sufficient quantities of bird spike strips will be installed on each surface specified for bird control.

B. Make sure all installation surface finishing requirements have been accomplished before installing bird barrier spikes.

C. Treat, neutralize and safely remove all bird waste from installation surfaces. Installer must follow all municipal, state and federal regulations regarding the proper removal and disposal of bird droppings and waste materials such as nests and dead birds.

D. Use manufacturer's approved surface cleaning products to neutralize any bird droppings, nests and related waste materials that may be present. Do not use cleaning products that will damage the mounting surface materials and finishes. Allow all surfaces to air dry completely, and then reapply to sanitize and deodorize the surface before proceeding.

3.3 INSTALLATION

A. Install in strict accordance with manufacturer's spike strip spacing and installation guidelines. Protect all surfaces where pest birds can land, roost and nest.

B. Install bird spike strips so they will protect the entire surface, not just the outside edges. No gaps are allowed in the bird spike strip coverage. Cut the bird spike strips where necessary to fit the surface properly.

C. Wires must extend over outside edges of each surface by at least 1/4-inch (0.6cm). The bird spike base strip must extend over the ends of each surface by at least 1/2-inch (1.2cm).

D. Fasten bird barrier spikes to the surface with the mounting hardware recommended by the manufacturer. Follow the hardware spacing guidelines and installation procedures supplied by manufacturer.

3.4 CLEANING

A. Remove debris and waste materials from project site. Inspect finished installation. Make any adjustments needed to conform to manufacturer's spacing and installation guidelines

END OF SECTION 108113

SECTION 126723 - BENCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bus Station seating including benches and lean rails.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For benches and lean rails to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area in accordance with manufacturer’s instructions. Keep materials in manufacturer’s original, unopened containers and packaging until installation.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

1.6 WARRANTY

A. Products will be free from defects in material and/or workmanship for a period of three years from the date of invoice.

PART 2 - PRODUCTS

2.1 SEATING

A. Benches:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Landscape Forms; Generation 50 or a comparable product by one of the following:
   a. Columbia Cascade Company.
   b. DuMor Inc.
   c. Forms+Surfaces.
   d. Keystone Ridge Designs, Inc.
2. Style: Cantilever, surface mount.
3. Back Style: Backless.
4. Arm Style: No arms.
5. Materials:
   a. Seat: 2-3/16 inch x 1-3/8 inch solid wood boards. All boards have eased edges as well as ends.
      1) Wood for Exterior Use: Domestically sourced thermally modified ash.
   b. Framework:
      1) Supports: 319 or 356 cast aluminum
      2) Center strap: 6063-T52 formed aluminum extrusion
      3) Board attaching hardware: carbon steel with Magni-coat
      4) Cantilever surface mount plate: 0.375-inch thick 6061-T651 ASTM B209 aluminum plate
   c. Anchoring: Provide manufacturer's standard, non-corrosive hardware for surface-mount, cantilever anchoring.
6. Finish: Powder-coat aluminum components.
   a. Color: Black.

B. Lean Rails:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Brasco International; Eclipse Leaning Rail or a comparable product by one of the following:
   a. Forms+Surfaces.
   b. Keystone Ridge Designs, Inc.
2. Mounting: Surface-mounted to station walls.
3. Materials: Solid aluminum frame with perforated aluminum infill.
4. Finish: Powder coated.
   a. Color: Black.

2.2 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.3 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of seating where required.

B. Install seating level, plumb, true, and securely anchored at locations indicated on Drawings.

END OF SECTION 126723

SECTION 238300 – RADIANT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes ceiling mounted electric infrared heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For ceiling mounted electric infrared heaters to include in operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Brominc – Tungsten Series

B. Detroit Radiant – DGS Series

C. Solaira – Alpha Series

2.2 DESCRIPTION

A. Assembly including chassis, electric heating coil, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 HOUSING

A. Surface-Mounted Enclosure: Aluminum or Stainless Steel construction. Provide a chrome-plated or stainless-steel wire guard to prevent heating elements from accidental damage. Furnish swivel brackets to position heater in any horizontal angle.

B. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested ceiling heaters before shipping

2.4 HEATING ELEMENT

A. Filtered short wave emitter technology with peak infrared wavelength between 1000 – 1300 nm. Emitters will be manufactured utilizing tubular quartz with tungsten coil and shall be glare reducing, thermal shock resistant for outdoor use with parabolic rear reflector.

2.5 CONTROLS

A. Controls: Separately mounted heavy-duty timer switch with user settable 1-60 minute time increments. Switch to be wet-location rated.

2.6 CAPACITIES AND CHARACTERISTICS

A. Heating Coil: 1500 kilowatts.

B. Electrical Characteristics for Single-Point Connection:

1. Volts: 208-240
2. Phase: 1
3. Hertz: 60

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive ceiling radiant heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before radiant-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install ceiling radiant heaters to comply with NFPA 90A.

B. Install ceiling radiant heaters level and plumb.

C. Install surface-mounted timer switch as shown on plan.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 238300

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.
3. Firestopping of electrical installation

1.3 SUBMITTALS

A. General

1. Make all submittals in accordance with Division 1, herein, and individual sections in Divisions 26.
2. Identify all submittals with corresponding specification section number and name. Each submittal shall typically be limited to one specification section, except in cases where similar equipment or services are commonly furnished in one package, e.g., short-circuit, coordination, and arc-flash studies; or low-voltage distribution equipment such as switchboards, panelboards, disconnects, and motor controls; or interior lighting, exterior lighting, emergency and exit lighting.
3. Clearly identify all submittals with project name and location, and manufacturer's name. Contractor shall thoroughly review and approve all submittals for accuracy and completeness prior to submitting to Architect. Mark each submittal with company name, reviewer's initials and date of review. Submittals not so approved and marked will be rejected, and resubmittal will be required.
4. Provide a complete list of all requirements for which submitted products are NOT in conformance with Specifications and Drawings, and associated reasons for non-conformance. Unless noted otherwise on submittal, products are assumed to meet all Specification and Drawing requirements and are expected to be furnished in accordance with those requirements.
5. Clearly mark product data copies to identify pertinent products, models, or part numbers. Circle, highlight, or otherwise clearly identify specific items that are being proposed on the submitted product data or shop drawings. Show performance characteristics and capacities, dimensions and clearances required, and wiring diagrams and controls.

6. Submit indexed and bound sets of shop drawings and/or product data sheets for items listed in individual sections of Divisions 26 prior to ordering material and starting construction.
7. Re-submittals shall be new and complete, void of previous submittal comments and engineer's review stamp, revised to incorporate all comments and additional information as noted or requested on previous submittals, and inclusive of all previous submittal information not requiring revisions.
8. Submit a minimum of one (1) electronic copy and two (2) hard copies of bound and indexed operation and maintenance instruction manuals, parts lists, new and revised, up-to-date shop drawings and product data sheets, void of previous submittal comments and engineer's review stamp, incorporating all previous comments, additional requested information, addendum and bulletin changes, etc., and record drawings for items listed in individual sections of Divisions 26 test reports, as part of close-out documents.
9. Submit documentation of electrical inspection final approval.

1.4 QUALITY ASSURANCE

A. Furnish only new, first-class quality, materials and equipment, delivered, erected, connected and finished in every detail, selected and arranged to fit properly into building spaces. Where no specific kind or quality of material is specified, furnish first-class standard article, approved by Architect.

B. Furnish services of one or more experienced superintendents, to be in charge of installation of work, and all skilled workmen, electricians and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. Provide all component parts of each item of equipment or device with manufacturer's nameplate, giving name of manufacturer, description, size, type, serial number, electrical characteristics, etc., to facilitate maintenance or replacement. Nameplate of Subcontractor or distributor is not acceptable.

D. Job conditions, which govern when and how products shall be installed, are generally covered in Division 1 and specifically covered in individual paragraphs of Division 26.

E. Do NOT install any product where it might be exposed to environment that is extremely different to that in which it was intended to be normally used.

F. Perform all work in close cooperation with other trades and utility companies.

G. Comply with latest edition or revision of each standard or code mentioned in these specifications and as follows:

1. American National Standard Institute (ANSI)
2. American Society for Testing Materials (ASTM)
3. National Electrical Manufacturer's Association (NEMA)
4. Underwriters' Laboratories (UL)
5. National Fire Protection Association (NFPA) -
6. State and Local Municipality Building and Electrical Codes and Ordinances.

H. 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.

I. Execute all work in conformity with best standards of practice. Lay out and install work in accordance with drawings, manufacturer's instructions, shop drawings, and field layouts of other trades.

J. Drawings are diagrammatic and indicate the general arrangement and intent of systems and work included in these documents.

K. Furnish all labor, material and equipment to install and successfully test electrical systems and work, complete and in place, as herein specified and as shown on drawings.

L. Program all monitoring and control systems for all equipment with input from Owner.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 for general requirements pertaining to delivery, storage and handling.

B. Protect materials before, during and after installation.

C. In event of damage, immediately make all repairs and replacements necessary at no additional cost.

D. Deliver all materials to job-site in original unopened containers, where applicable, with all labels intact and legible at time of use. Store in strict accordance with manufacturer's recommendations.

E. Examine all equipment and material delivered to jobsite prior to installation to ensure all specification requirements and shop drawing notes and comments have been incorporated by manufacturer. Installation of equipment or material signifies Contractor’s acceptance and approval of equipment or material from manufacturer.

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. In cases of interferences between various items of equipment and building features, or if simplified construction is made possible by relocation of certain equipment, bring such conditions to attention of Architect. Changes in arrangements may be made only if authorized by Architect.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

E. Substitutions and Changes

1. Comply with Instructions to Bidders.
2. Contractor is responsible to notify all parties concerned of any changes or substitutions he has been authorized to make, and must include in his notice a full description, including drawings if necessary, of any deviation from dimensions shown on plans of any trade.
3. If Contractor provides equipment other than that upon which design is based, it shall be his responsibility to coordinate its installation with work of all other trades and with space available, and pay for any changes caused to other trades as a result of this substitution.
4. If other contractors provide equipment other than that upon which design is based, electrical contractor shall coordinate electrical equipment and connections, including sizes of switches, fuses, breakers, starters, wiring, etc., with requirements of furnished equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material shall be produced by company which has been engaged in manufacture of such types of materials for period of at least five (5) years.

B. Provide electrical products as described under specific paragraphs in this division. Refer to various paragraphs for correct product identification (e.g. “Low-Voltage Electrical Power Conductors and Cables”, Section 260519).

2.2 SPARE MATERIAL

A. Refer to individual sections for spare material requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Drawings constituting part of these documents are diagrammatic and indicate general arrangement of systems and work included in documents.

B. Coordinate necessary preparation required for electrical equipment installation with all trades.

C. Locate conduits, junction boxes, etc., to allow access to air terminal units, piping, control valves, etc., for maintenance and repair. Conversely ensure light fixtures, etc. are clear of piping etc. to allow access for maintenance.

D. Verify locations of outlets and types of connections required for equipment installed by others.

E. Relocate any improperly located outlet, and replace any incorrect connection caused by lack of preparation or coordination. Also, repair to the Architect's/Owner's satisfaction any hole, etc., caused by these relocations/replacements.

3.2 ADJUSTMENTS AND CLEANING

A. Cutting and Patching

1. Do all cutting and patching necessary for installation of electrical work with approval, and under supervision of, Architect.
2. Do not impair strength or function of work being cut or patched, i.e., do not weaken structural members and waterproof holes through exterior walls and ground floor. Use rotary type drilling tools and concrete cutting saws to cut concrete and masonry walls. Do not use torches for cutting steel.

B. Wall, Floor and Ceiling Openings

1. Place all sleeves necessary for electrical installation and advise other Contractors of all openings necessary for installation of electrical work.
2. Provide sleeves necessary for installation of video, data, sound, etc., system cables. If system wiring has not been installed at time of building official’s inspection, seal all sleeves. Subsequent penetrations and sealing will be done by System Contractor.
3. Repair and finish all holes placed for conduit if such holes are placed after general construction is completed.

C. Excavation and Backfill

1. Perform excavation and backfilling necessary to install the electrical system in accordance with Contract Documents and appropriate sections of Divisions 26.

D. Concrete Work

1. Bases for outdoor lighting standards, raised pads for switchboards, distribution panels, switchgear, substations and similar equipment, and pads for transformers, including the setting of mounting bolts, constructed by Division 3 Contractor.
2. Furnish mounting bolts, place conduit; and deliver mounting and placement templates to Division 3 Contractor.

E. Painting

1. Furnish panelboards and cabinets in finished areas with prime coat of paint. Furnish panelboards and cabinets in unfinished areas with standard factory finish.
2. Paint all fire alarm system panels, emergency panels and associated junction boxes, and pull boxes red.

F. Protection

1. Provide final protection of all electrical conduit, wiring, enclosures, equipment and panels, and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of substantial completion.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
3. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
4. Protect all electrical and electronic equipment from falling metal shavings before and during construction.

G. Housekeeping and Clean-up

1. Remove from site all debris and rubbish accumulating as result of electrical installation. Dispose of all debris and rubbish. Leave all electrical equipment rooms broom clean.
2. Clean interiors of all cabinets, pull boxes, and equipment enclosures. Clean all electrical equipment, including lighting fixtures, at time of Substantial Completion.
3. Refer to Division 1 for additional requirements.

3.3 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Install all equipment and systems according to manufacturer's recommendations, and as outlined in individual paragraphs of these documents, to provide complete and totally operational systems.

C. Comply with working clearances and dedicated spaces per NEC Article 110.

D. Mount all equipment on exterior walls and in damp and wet locations on steel channel support providing separation between equipment and mounting surface(s).

E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

G. Right of Way: Give to piping systems installed at a required slope.

3.4 FIRESTOPPING

A. Firestop Systems for Electrical Low-Voltage Cabling Sleeves:

1. Provide for re-penetration of cables.
2. Smoke gaskets shall eliminate need for sealant or putty.
3. Hilti Firestop Speed Sleeves, Model CP653BA.

    a. Nominal size 2", with 1.7" inside diameter, 2.3" outside diameter, 4.7" flange, 12.4" length.
    b. Nominal size 4", with 3.6" inside diameter, 4.3' outisde diameter, 4.7" flange, 12.4" length.

3.5 FIELD QUALITY CONTROL

A. Conduct following tests on electrical installation during the course of construction:

1. Test conductors for grounds and shorts.
2. Test ground system.
3. Test all ground fault protection equipment before temporary service is removed. Obtain test procedure from manufacturer and review procedure with Architect before conducting test.
4. Test phasing of panelboards for compliance with NEC Article 408.
5. Test other systems as recommended by system manufacturer and as specified elsewhere.

B. Upon completion of the project:

1. Adjust voltage taps on all transformers for an optimum operating level.
2. Aim all adjustable lighting fixtures.
3. Adjust all auxiliary systems for optimum performance.
4. Measure load balance under near full-load conditions on all panelboards with true RMS reading meters, and reconnect loads as may be necessary to obtain reasonable balance of load between phases. Relabel affected equipment, devices, junction boxes, wiring, panelboard directories, etc., due to load reconnection and branch circuit number changes. Provide two (2) copies of final balance report indicating measured load current on each phase and neutral current for each panelboard.

5. Perform following tests and inspections, to verify tightness of connections, and prepare reports.

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of all electrical connections in switchgear, switchboards, panelboards, switches, circuit breakers, motor controls, busway, transformers, generators, transfer switches, etc., and each splice in cables and conductors for No. 3 AWG and larger, while carrying normal load. Remove front and rear covers of equipment and boxes so joints, splices, and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of 11 months after date of Substantial Completion.
    c. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record device.
    d. Report: Prepare a certified report that identifies each piece of equipment checked and describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Photovoltaic cable, Type PV.
4. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. No submittals required.

B. Product Data: For each type of product.

C. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Certified field quality-control reports.

B. Length of cables for each feeder on project, including cabling to distribution equipment (distribution panelboards, panelboards, busway, etc.). Branch circuits are not included in the requirement. Include both estimated length used for bidding and actual length installed, for use in short-circuit, coordination and arc flash hazard studies.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.
10. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 ASTM B 496 for stranded conductors.

E. Conductor Insulation:

1. Comply with NEMA WC 70/ICEA S-95-658.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type RHH and Type RHW-2: Comply with UL 44.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with UL 83.
6. Type XHHW-2: Comply with UL 44.

F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Okonite Company (The).
7. Service Wire Co.
8. Southwire Company.
9. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569 and NEC Article 330.
3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:

1. Single circuit.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel or Aluminum, interlocked.

I. Jacket: PVC applied over armor.

2.3 PHOTOVOLTAIC CABLE, TYPE PV

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600V.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Okonite Company (The).
7. Service Wire Co.
8. Southwire Company.
9. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation:

1. Comply with UL 44 and UL 4703.

2.4 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. FCI - Burndy Products.
4. Gardner Bender.
5. Hubbell Power Systems, Inc.
6. Ideal Industries, Inc.
7. ILSCO.
8. NSi Industries LLC.
9. O-Z/Gedney; a brand of Emerson Industrial Automation.
10. Service Wire Co.

11. TE Connectivity Ltd.
12. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Duplex connectors for Type MC cable, permitting termination of (2) cables per fitting, are not acceptable.

E. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper or Aluminum as required for conductor material.
2. Type: One or Two hole with standard or long barrels as required.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Stranded copper for feeders smaller than No. 4 AWG; stranded copper or aluminum for feeders No. 4 AWG and larger. Conductors shown on drawings are sized as copper. Provide aluminum conductors with equivalent ampacity and impedance to copper conductors shown on drawings. Increased conductor, lug, and conduit fill sizing are responsibility of Electrical Contractor. Note that lugs must be suitable for aluminum regarding size and material.

B. Branch Circuits: Stranded copper.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type USE, single conductor in raceway.

B. Exposed Feeders: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway, Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

H. VFC Output Circuits: Type XHHW-2 in metal conduit Type TC-ER cable with braided shield Type TC-ER cable with dual tape shield.

I. PV Circuits, Type PV: For PV source circuits rated at 600V.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Do not use conductors smaller than No. 12 AWG for branch circuit wiring.

B. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables. Install wiring after concrete and masonry work is complete and after moisture is swabbed from conduit.

D. Make conductor lengths for parallel feeders identical.

E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

H. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems." Secure cables at not more than 30 inch (760 mm) intervals, nor more than 6 inches (150 mm) from boxes, cabinets, racks, outlets, etc.

I. Lace or clip groups of feeder conductors at distribution centers, pull-boxes and wireways.

J. Use No. 10 AWG minimum wire size from panelboard to first outlet for any 277 volt branch circuit exceeding 125 feet between branch circuit panel and first outlet, and for any 120 volt branch circuit exceeding 75 feet between branch circuit panel and first outlet. Increase wire size one size for each additional 125 feet of length for any 277 volt branch circuit, and for each additional 75 feet of length for any 120 volt branch circuit, and adjust conduit size as required.

K. Based upon final feeder or branch circuit routing, up-size conductors to provide a maximum voltage drop of 2 percent for feeders and 3 percent for branch circuits, and a maximum voltage drop on both feeders and branch circuits of 5 percent, as described in NEC Articles 210.19A and 215.2A1 information notes.

L. De-rate branch circuit conductors for multiple home-runs sharing a single raceway per NEC Article 310.15B3.

M. Provide an individual neutral conductor for each phase conductor of branch circuits. Common neutral conductors are NOT allowed.

N. Provide separate neutral conductors for dimmer controlled lighting circuits.

O. Install only switch legs in conduits to switch boxes. Do NOT route power supply conductors through lighting switch boxes.

P. Install emergency system wiring in separate raceways from all other systems.

Q. Install receptacle and lighting circuits in separate raceways.

R. Make connections only in junction, pull and outlet boxes; terminal cabinets; and equipment enclosures.

S. Visually inspect, then test all feeders for grounds and short circuits prior to energizing the cable. Replace defective runs, or repair them at Architect's option.

T. Equip each MC cable termination with anti-shorting thermoplastic insulated bushing. Use MC connectors, fittings and tools only. Do not use MC cable in hazardous or wet locations, or for feeders. Do not run MC cable directly into panelboards.

U. Duplex connectors for Type MC cable, permitting termination of (2) cables per fitting, are not acceptable.

3.4 INSTALLATION OF CABLES NOT ENCLOSED IN RACEWAY

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Install cables per manufacturer’s recommendations without damaging conductors, shields, or jackets.

C. Install exposed cables parallel and perpendicular to building lines and surfaces of exposed structural members. Follow surface contours where possible.

D. Support cables according to Division 26 Section 260529 “Hangers and Supports for Electrical Systems.” Secure cables at not more than 30 inch (760 mm) intervals nor more than 6 inches (150 mm) from boxes, cabinets, racks, outlets, etc.

E. Do not bend cables at less than 1.5 times manufacturer’s recommended minimum bending radii.

F. Do not exceed manufacturer’s recommended maximum pulling tensions.

G. Do not splice, tap, or terminate cables other than in outlets, terminals, or panels or cabinets.

H. Protect cables passing through metal studs, walls, etc., with suitable rubber grommets or conduit sleeves.

I. Separate unshielded voice, video, and data communication cables from EMI sources, power cables, transformers, and power equipment per TIA/EIA 569A requirements.

3.5 CONNECTIONS

A. Use screw on wire connector for copper conductor sizes No. 10 gauge and smaller except at motor connections. Use tool applied compression or split bolt type for all motor connections and for conductors larger than #10. Protect compression and split bolt type splices with suitable electrical tape.

B. Size all connectors to match cable size.

C. Use tools recommended by vendor for applying pressure connectors.

D. Suitable terminal lugs that are factory installed on equipment may be used for terminating cables.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

F. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

G. Splice only in accessible junction or outlet boxes.

H. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

    a. Verify conductor and cable data matches drawing and specification requirements.
    b. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    c. Test bolted connections for high resistance using one of the following:

        1) A low-resistance ohmmeter.
        2) Calibrated torque wrench.
        3) Thermographic survey.

    d. Inspect compression-applied connectors for correct cable match and indentation.
    e. Inspect for correct identification.
    f. Inspect cable jacket and condition.
    g. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    h. Continuity test on each conductor and cable.
    i. Uniform resistance of parallel conductors.
    j. Verify color coding meets specification requirements.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each connection or splice in conductors No. 3 AWG and larger. Remove box and equipment covers so connections or splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

b. Record of Infrared Scanning: Prepare a certified report that identifies connections or splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each connection or splice 11 months after date of Substantial Completion.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
1. Ground rods.
2. Ground rings.
3. Grounding arrangements and connections for separately derived systems.

B. Certified field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
1) Ground rods.
2) Ground rings.

3) Grounding arrangements and connections for separately derived systems.

b. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.
11. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Tinned Conductors: ASTM B 33.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of tin-plated annealed copper, 1/4 by 4 inches in cross section, 12 inches minimum length, with 9/32-inch holes spaced 1-1/8 inches apart for NEMA 2-hole connectors and insulators, wall-mounted steel mounting brackets, insulators and holes for NEMA 2-hole connectors and insulators, unless otherwise indicated. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V, and shall be Lexan or PVC, impulse tested at 5000 V.

1. Harger Series T-GBI-M for power grounding applications.
2. Harger Series GBI-TMGB for telecommunications grounding applications, with 12-inch or 24-inch length as indicated. Meet BICSI and EIA/TIA 607 Standards.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Underground Connectors: Cadweld exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions, or Burndy Hyground irreversible compression-type, UL listed, except in ground test wells which require heavy-duty UL listed, bolted connections.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

I. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

J. Straps: Solid copper, cast-bronze clamp copper lugs. Rated for 600 A.

K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one two-piece clamp.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Die-cast zinc alloy.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded or irreversible compression-type connectors except as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install at least three ground rods, separated by at least twenty (20) feet, and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install No. 4/0 AWG tinned-copper conductor for ground ring and for taps to equipment grounding terminals. Route taps in one inch (25 mm) nonmetallic conduit from two points on ground ring. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Signal and Communication Equipment: For alarm, voice and data, and other communication equipment, provide one (1) No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch minimum grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. After completion of individual ground rod resistance tests, interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three ground rods separated by at least twenty (20) feet from each other and located at least the same distance from other grounding electrodes, and interconnected with No. 4/0 AWG bare grounding conductors and from two points on grid to ground bus in service equipment.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Building Expansion Joints and Conduit Expansion Fittings: Install bonding jumper to maintain continuous ground continuity.
3. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
4. Use exothermic-welded or irreversible compression-type connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding for Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.

1. Install No. 4/0 AWG tinned-copper conductor for ground ring and for taps to building columns.
2. Bury ground ring not less than 24 inches from building's foundation.

G. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.
    c. Measurement of ground grid and building ground ring resistance must be accomplished using AVO Biddle's Slope Method where rods have been connected to grids or building ground rings prior to testing. If measurements do not meet requirements cited above, take corrective action as required. Re-measure grid resistance to ground until acceptable values are achieved.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Measured ground resistances shall not exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment and Raised Floor Systems: 1 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole, Building Ground Ring, and Fence Grounds: 5ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, install additional ground rods and conductors as required. Re-measure grid resistance to ground until acceptable values are achieved.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.3 ACTION SUBMITTALS

A. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. ERICO International Corporation.
d. Flex-Strut Inc..
e. GS Metals Corp.
f. G-Strut.
g. Haydon Corporation.
h. Metal Ties Innovation.
i. Thomas & Betts Corporation; A Member of the ABB Group.
j. Unistrut; Part of Atkore International.
k. Wesanco, Inc.

2. Standard: Comply with Metal Framing Manufacturer's Association Standard MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron Stainless-steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Hilti, Inc..
2) ITW Ramset/Red Head; Illinois Tool Works, Inc..
3) MKT Fastening, LLC.
4) Simpson Strong-Tie Co., Inc..

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) B-line, an Eaton business.
2) Empire Tool and Manufacturing Co., Inc..
3) Hilti, Inc..
4) ITW Ramset/Red Head; Illinois Tool Works, Inc..
5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 105.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Support overhead electrical systems from building structural framing. Do NOT support electrical systems from roof decks, floor slabs, pipes, ducts, mechanical equipment, or other conduit, except as noted.

1. Electrical system support hanger loads less than 70 pounds may be suspended from floor slabs with preset inserts or approved anchors.
2. For concrete frame construction, electrical system support hanger loads less than 200 pounds may be suspended from floor or roof slabs with preset inserts or approved anchors.
3. If necessary, install appropriately sized steel support members spanning structural framing members to support electrical systems.

D. Do NOT support conduits or cables from suspended ceilings unless they are 1/2 inch or smaller trade size branch circuit conduits or cables that conform to NEC 300.11 and feed only equipment mounted in or on suspended ceiling.

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

H. Mounting straps for non-metallic conduit shall allow movement during expansion and contraction, yet secure conduit to structure.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: Use methods described in NECA 1.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that [meet][comply with seismic-restraint] strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with manufacturer’s installation requirements for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. For following systems:

1. Electrical power wiring.
2. Communications systems, including telephone and data.
3. Video distribution system.
4. Sound systems, including paging, intercom, sound reinforcement.
5. Security systems, including card access, video CCTV, door monitoring.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, tele-power poles, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Allied Tube & Conduit; a part of Atkore International.
    c. Anamet Electrical, Inc.
    d. Calconduit.
    e. Electri-Flex Company.
    f. FSR Inc.
    g. Korkap.
    h. Opti-Com Manufacturing Network, Inc (OMNI).
    i. O-Z/Gedney; a brand of Emerson Industrial Automation.
    j. Patriot Aluminum Products, LLC.
    k. Perma-Cote.
    l. Picoma Industries, Inc.
    m. Plasti-Bond.
    n. Republic Conduit.
    o. Southwire Company.
    p. Thomas & Betts Corporation; A Member of the ABB Group.
    q. Topaz Electric; a division of Topaz Lighting Corp.
    r. Western Tube and Conduit Corporation.
    s. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.

8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Allied Tube & Conduit; a part of Atkore International.
    c. Anamet Electrical, Inc.
    d. Calconduit.
    e. Electri-Flex Company.
    f. FSR Inc.
    g. Korkap.
    h. Opti-Com Manufacturing Network, Inc (OMNI).
    i. O-Z/Gedney; a brand of Emerson Industrial Automation.
    j. Patriot Aluminum Products, LLC.
    k. Perma-Cote.
    l. Picoma Industries, Inc.
    m. Plasti-Bond.
    n. Republic Conduit.
    o. Southwire Company.
    p. Thomas & Betts Corporation; A Member of the ABB Group.
    q. Topaz Electric; a division of Topaz Lighting Corp.
    r. Western Tube and Conduit Corporation.
    s. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

    a. Material: Steel. Die cast type are not allowed.
    b. Type: Setscrew.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
9. Bushings: Impact resistant plastic, 105 deg C rated. Grounding type shall be insulated steel with proper ground lug.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.
    e. CertainTeed Corporation.
    f. Champion Fiberglass, Inc.
    g. Condux International, Inc.
    h. Electri-Flex Company.
    i. FRE Composites.
    j. Kraloy.
    k. Lamson & Sessions.
    l. Niedax Inc.
    m. RACO; Hubbell.
    n. Thomas & Betts Corporation; A Member of the ABB Group.
    o. Topaz Electric; a division of Topaz Lighting Corp.
    p. United Fiberglass.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:

    a. Comply with NEMA TC 14.
    b. Comply with UL 2515 for aboveground raceways.
    c. Comply with UL 2420 for belowground raceways.

4. RNC: Type EPC-40-PVC and EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

    a. Utilize PVC coated rigid steel conduit elbows for sizes 1-1/4 inch and larger, unless phase conductors are indicated to be installed in separate conduits.

5. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.

e. CertainTeed Corporation.
f. Champion Fiberglass, Inc.
g. Condux International, Inc.
h. Electri-Flex Company.
i. FRE Composites.
j. Kraloy.
k. Lamson & Sessions.
l. Niedax Inc.
m. RACO; Hubbell.
n. Thomas & Betts Corporation; A Member of the ABB Group.
o. Topaz Electric; a division of Topaz Lighting Corp.
p. United Fiberglass.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Lamson & Sessions.
4. Niedax Inc.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Cutler-Hammer; Eaton Corporation.
3. Crouse-Hinds, an Eaton business.
4. EGS/Appleton Electric.
5. Erickson Electrical Equipment Company.
6. FSR Inc.
7. General Electric Co.; Electrical Distribution & Control Division.
8. Hoffman; a brand of Pentair Equipment Protection.
9. Hubbell Incorporated.
10. Hubbell Incorporated; Wiring Device-Kellems.
11. Kraloy.
12. Milbank Manufacturing Co.
13. MonoSystems, Inc.
14. Oldcastle Enclosure Solutions.
15. O-Z/Gedney; a brand of Emerson Industrial Automation.
16. Plasti-Bond.
17. RACO; Hubbell.

18. Siemens Energy & Automation, Inc.
19. Spring City Electrical Manufacturing Company.
20. Square D; Group Schneider.
21. Stahlin Non-Metallic Enclosures.
22. Thomas & Betts Corporation; A Member of the ABB Group.
23. Topaz Electric; a division of Topaz Lighting Corp.
24. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloyaluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable Semi-adjustable.
3. Shape: Rectangular, unless otherwise indicated.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep Insert dimension.

L. Gangable boxes are prohibited.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1, unless otherwise indicated, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel, sized as indicated on Drawings.
2. Hinged door in front cover with flush latch and concealed hinge and screws. Size door to allow access to terminals without removing cover.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Plywood backboard, 3/4 inch (19 mm) thick, finished with fire retardant sealer.
6. Terminal Strips

    a. Below 50 volts: Screw terminal type.
    b. 51 to 250 volts: 250 volt screw terminal type with barrier between each set of terminals and individual terminal points for each conductor.
    c. 251 to 600 volts: 600 volt terminal strips similar to (b) above.

7. Accessory feet where required for freestanding equipment.
8. Identification

    a. Identify terminal strips with permanent numbers.

9. Wiring Diagrams

    a. Provide wiring diagram on inside of each cabinet door showing units and conductors connected to cabinet.

2.6 HANDHOLES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes:

1. Handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Quazite: Hubbell Power Systems, Inc.
    b. Or approved equal.

2. Standard: Comply with SCTE 77.
3. Size: As indicated on Drawings
4. Load Rating: UL listed and labeled for Tier 10 loading, with 10,400 lb. design load and 22,568 lb. minimum test load.

5. Color of Frame and Cover: Gray.
6. Configuration: Designed for flush burial with two (2) stackable sections and open bottom unless otherwise indicated.
7. Cover: Weatherproof, gasketed, secured by stainless-steel, tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
8. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
9. Cover Legend: Molded lettering, "ELECTRIC.", "COMMUNICATIONS", or other lettering as required by type of cables being installed.
10. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
11. Handholes 12 Inches Wide by 24 Inches Long Insert dimensions and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 BACKBOARDS FOR TERMINATION OF SYSTEMS WIRING

A. Description: 3/4 inch (19.1 mm) thick, exterior type, A-C grade plywood. Provide one (1) 4 foot by 8 foot piece per location, unless otherwise shown on Drawings.

B. Finish: Two (2) coats of UL listed fire-retardant paint.

2.8 WALLPLATES

A. To match other wiring device wallplates. Refer to Section 262726 “Wiring Devices.”

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit, Not Subject to Physical Damage: GRC, IMC, RNC, Type EPC-40-PVC RNC, Type EPC-80-PVC.
2. Exposed Conduit, Subject to Physical Damage: GRC, IMC, RNC, Type EPC-80-PVC.
3. Concealed Conduit, Aboveground: GRC IMC RNC, Type EPC-40-PVC.
4. Covered Locations, Open to Exterior: GRC, IMC.
5. Exposed Conduit, Parking Ramps and Garages: RNC, Type EPC-80-PVC.
6. Underground Conduit:

    a. RNC, Type EPC-40-PVC Type EPC-80-PVC, direct buried.
    b. RNC, Type EPC-40-PVC in concrete on grade
    c. Type EB-20 for concrete encased duct bank.

7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
8. Exposed Boxes and Enclosures, Aboveground: NEMA 250, Type 4. Rigid PVC construction with suitable covers, UL rated for 90 degree conductors.
9. Boxes Flush Mounted in Building Walls, Exterior Side: Weatherproof cast aluminum outlet box, gasketed extension as required, plugs for all unused openings, ground screw mounting lugs, zinc die-cast weatherproof cover, grey finish.
10. Terminate PVC conduit prior to entering building in suitable PVC-to-rigid steel conduit adaptor fitting.
11. Handholes for Underground Wiring:

    a. Handholes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete units, SCTE 77, Tier 15 structural load rating.
    b. Handholes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
    c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77, (13 345-N) Tier 5 structural load rating.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit, Not Subject to Physical Damage: EMT.
2. Exposed Conduit, Subject to Physical Damage: GRC or IMC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

3. For Supporting Lighting Fixtures: GRC or IMC.
4. Circuits over 600 Volts: GRC or IMC, except where RNC is specified.
5. Hazardous Locations: GRC or IMC.
6. Conduit in All Concrete, Except Concrete on Grade: GRC.
7. Conduit Concealed in Ceilings and Interior Walls and Partitions: EMT.
8. Connection to Recessed Lighting Fixtures: FMC, except use LFMC in damp or wet locations.
9. Connection to Vibrating Equipment Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment: LFMC, except use FMC in dry locations for 120 volt motors 1/3 HP or less. Provide only sufficient length of flexible conduit necessary to avoid transmission of vibrations.
10. Conduit, Damp or Wet Locations: GRC or IMC.
11. Boxes and Enclosures, Indoor Dry Locations: NEMA 250, Type 1, hot dip galvanized construction or cadmium plated, pressed sheet steel, blanked for conduit, attached lugs for mounting, full access screw-on or hinged cover. Provide flush mounted boxes with overlapping cover with flush-head cover retaining screws, prime coated.

a. Ceiling Outlet Boxes, Flush or Surface Mounted: 4 inch by 2-1/8 inch deep (102 mm x 54 mm deep), octagonal boxes for receiving three or less 1/2 in. (12 mm) conduits.
b. Wall Outlet Boxes, Flush Mounted, Gypsum Wallboard

1) 4 inch by 2-1/8 inch deep (102 mm x 54 mm) square boxes with matching square-drawn/tile cover for single or two (2) gang outlets.
2) 4-11/16 inch by 2-1/8 inch deep (119 mm x 54 mm) square boxes with matching square-drawn/tile covers for single or two (2) gang outlets. Use for all 1 inch or 1-1/4 inch conduit entries.
3) 2-1/2 inches deep (64 mm) gangable switch boxes at wall switch locations.
4) 4 inch by 3-1/2 inch deep (102 mm x 89 mm) square boxes with matching square-drawn/tile cover for single or two (2) gang outlets. Use for all communication/data outlets, unless wall thickness dictates shallower box.

c. Wall Outlet Boxes, Flush Mounted, Masonry: 3-1/2 inches (89 mm) deep masonry boxes, single or multiple gang, as required or as indicated on the Drawings.
d. Wall Outlet Boxes, Surface Mounted: 4 inches by 2-1/8 inches deep (102 mm x 54 mm) square.

12. Outlet Boxes, Indoor Damp or Wet Locations, Equipment connections in Shops: NEMA 250, Type 4. Type FD (deep) or FS (shallow) cast device box, copper-free aluminum, blank body for drilling and tapping of required openings, gasketed extension as required, ground screw, aluminum gasketed, wet location cover, stainless steel screws.
13. Outlet Boxes, Flush Mounted in Building Walls, Exterior Side: Weatherproof cast aluminum outlet box, gasketed extension as required, plugs for all unused openings, ground screw, mounting lugs, zinc die-cast weatherproof cover, grey finish.
14. Boxes and Enclosures, Exterior Locations: Rigid PVC construction with suitable covers, UL rated for 90° conductors.

a. Wall Outlet Boxes: "FS" type, rigid PVC, UL rated for 90° conductors, or malleable iron. Die cast "Bell" boxes will not be allowed.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use set-screw, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports. Mount exposed conduits tight to walls. Provide offsets at boxes and equipment.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Coordinate installation of raceways in masonry and concrete with construction process.

D. Route conduit to avoid structural obstructions, minimizing crossovers.

E. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

F. Do not fasten conduits onto the bottom side of a metal deck roof.

G. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes and other heat sources. Install horizontal raceway runs above water and steam piping.

H. Install conduit free from dents and bruises. Plug ends to prevent entry or dirt or moisture.

I. Complete raceway installation and clean out raceway before starting conductor installation.

J. Arrange stub-ups so curved portions of bends are not visible above finished slab.

K. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

L. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

M. Conceal conduit within finished walls, ceilings, and floors, excluding overhead in rooms without finished ceilings, mechanical equipment rooms, connections to motors, and connections to surface panelboards, unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

N. Support conduit within 12 inches of enclosures to which attached.

O. Route all exposed conduits and conduits above dropped ceilings parallel or perpendicular to building lines. Locate as close to building surfaces or structure as possible.

P. Do NOT install conduit horizontally in slabs except where indicated on Drawings.

Q. Locate each conduit through roof separate sleeve provided under Division 7. Do NOT locate raceways in sleeves with other pipes. Coordinate all roof penetrations with roofing installation. Arrange raceways to cross expansion joints at right angles.

1. Install UL approved expansion fittings, complete with grounding jumpers, where metallic conduits cross building expansion joints.

R. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

S. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

T. Install bushings on all conduit terminations, except where insulated throat connectors are used. Use insulated steel type bushings where grounding or bonding is required. Use plastic type bushings at other locations.

U. To avoid conductor derating and mutual heating, do NOT group conduits in earth. Separate conduits immediately after leaving equipment.

V. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

W. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

X. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

Y. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Z. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

AA. Install pull wires in all empty and/or spare raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap all empty and/or spare raceways and install identification tags. Cap underground raceways designated as spare above grade alongside raceways in use.

BB. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

CC. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

DD. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

EE. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

FF. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

GG. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

HH. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

II. Seal around all conduits through walls and floors to maintain fire and smoke rating and prevent sound transmission.

3.3 INSTALLATION OF BOXES AND CABINETS

A. Conceal all pull boxes and junction boxes wherever possible. Mount boxes flush in all areas other than mechanical rooms, electrical rooms, and above removable ceilings.

B. Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms, or storage areas to permit access to interior of the box.

C. Size pull boxes and junction boxes to provide ample room for conductors, cable bends, and terminations where applicable. Utilize NEC as minimum sizing guide only.

D. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

E. Coordinate locations and mounting heights of outlets mounted above counters with built-in units, window sills, heating/cooling equipment, etc., prior to installation. Adjust outlet mounting height to agree with required location for equipment served.

F. Recessed Boxes in Masonry Walls: Coordinate cutting of masonry walls to achieve neat openings for boxes. Adjust position of outlets in finished masonry walls to suit masonry course lines. Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

G. Do NOT install boxes back-to-back in opposite sides of same wall or partition. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Do NOT use through-the-wall type boxes.

H. Locate boxes so that cover or plate will not span different building finishes.

I. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

J. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

K. Do NOT use sectional or handy boxes unless specifically requested.

L. Verify that there is insulation behind boxes mounted in exterior walls to prevent condensation in boxes.

M. Mount all outlet boxes plumb and parallel with door or window frames, countertops and other building lines.

N. Identify all conductors within pull boxes and junction boxes per Section 260553 - “Identification for Electrical Systems”.

O. Refer to Section 260500 - “Common Work Results for Electrical for openings in fire-rated walls, partitions, floors, and ceilings.

P. Securely anchor all fittings and boxes.

Q. Install one (1) 3/4 inch conduit in floor slab from low voltage compartment of each floor box to accessible ceiling plenum, unless noted otherwise.

R. Mount cabinets on, or in, wall with top of box no higher than 72 inches above floor.

S. Terminate conduit in cabinets with lock nut and bushing or lock nut and grounding bushing.

T. Terminate wiring in cabinets on terminal blocks or strips.

U. Vacuum clean cabinets on completion of installation.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.5 INSTALLATION OF UNDERGROUND HANDHOLES

A. Excavate sufficient material to provide sufficient space for installation of handhole and to perform work in satisfactory manner.

B. Install handholes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

C. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

D. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

E. Install handholes with bottom below frost line.

F. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

G. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

H. Ground handhole per Section 260526 - "Grounding and Bonding for Electrical Systems."

I. Plug all openings to prevent infiltration or leakage.

J. Provide two (2) entry tools for tamper resistant hardware.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 RACEWAY SYSTEMS FOR COMMUNICATIONS, VIDEO DISTRIBUTION, SOUND, AND SECURITY SYSTEMS WIRING.

A. Equipment and wiring will be installed under separate contract by Owner’s Special System Contractors.

B. Provide all raceway components, including cabinets, terminal boards, surface raceways, backboxes, baffles, conduit and boxes, as required to form a complete empty raceway system. Extend conduits and/or surface raceways to nearest accessible system cabinet, backboard, or terminal room.

C. Each run of conduit shall contain not more than two 90 degree bends and no run shall exceed 100 ft. in length. Minimum radii for bends: 9-1/2 inches for 3/4 inch conduit, 10-1/2 inches for 1 inch conduit, and a minimum of ten times the trade size diameter bends for larger sizes. Do NOT use conduit fittings in lieu of bends.

D. Provide bushed fittings on all conduit terminations.

E. Provide pullboxes in conduit runs exceeding 100 ft. (30 m) in length, and in runs with more than two right angle bends. Do NOT use conduit fittings in lieu of bends.

F. Identify all cabinets, and pull and junction boxes as to system usage.

G. Provide nylon pull cord in each conduit run.

H. Provide identification tags on all conduit runs.

I. Provide cover plates on all outlet boxes.

J. Provide plywood backboards and duplex receptacles in equipment room(s). Confirm location on job-site prior to installation. Paint all backboards with prime coat of fire resistant paint and finish coat of enamel in color to match wall. In unfinished rooms, provide gray finish coat.

K. Coordinate all work with Owner and Owner's Special System Contractor.

L. Provide underground conduit to property line for utility service entrance. Verify exact location with serving utility. Refer to Drawings for details.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 260500 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.
   e. Proco Products, Inc.

2. Sealing Elements: EPDM Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel Plastic Stainless steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels for equipment, wiring devices, control stations, etc.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.
10. Panelboard directories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with OSHA Specifications for accident prevention signs contained in the Code of Federal Regulations as 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Power Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for service feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.

3. Color for Equipment Grounds: Green.
4. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Power Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. High Voltage Warning: "WARNING - HIGH VOLTAGE - KEEP OUT".

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Champion America.
c. emedco.
d. Grafoplast Wire Markers.
e. HellermannTyton.
f. LEM Products Inc.
g. Marking Services, Inc.
h. Panduit Corp.
i. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: Preprinted Write-on, 3-mil- thick, polyester vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A'n D Cable Products.
b. Brady Corporation.

c. Brother International Corporation.
d. emedco.
e. Grafoplast Wire Markers.
f. Ideal Industries, Inc.
g. LEM Products Inc.
h. Marking Services, Inc.
i. Panduit Corp.
j. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. emedco.
e. Grafoplast Wire Markers.
f. HellermannTyton.
g. Ideal Industries, Inc.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Panduit Corp.
k. Seton Identification Products.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Champion America.
c. HellermannTyton.
d. Ideal Industries, Inc.
e. Marking Services, Inc.
f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.

C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HellermannTyton.
b. LEM Products Inc.
c. Marking Services, Inc.

d. Seton Identification Products.

D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Seton Identification Products.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Ideal Industries, Inc.
c. LEM Products Inc.
d. Marking Services, Inc.
e. Reef Industries, Inc.
f. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE" .
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Tag:

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright yellow-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
b. Width: 3 inches.

c. Overall Thickness: 5 mils.
d. Foil Core Thickness: 0.35 mil.
e. Weight: 28 lb/1000 sq. ft..
f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.
e. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened printed permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Grafoplast Wire Markers.
e. LEM Products Inc.
f. Marking Services, Inc.
g. Panduit Corp.
h. Seton Identification Products.

C. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. LEM Products Inc.
c. Seton Identification Products.

2. Polyester Tags: 0.010 inch Insert dimension thick, with corrosion-resistant grommet and cable tie for attachment.

3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlton Industries, LP.
    b. Champion America.
    c. emedco.
    d. Marking Services, Inc.

2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Champion America.
    c. emedco.
    d. Marking Services, Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. in., minimum 1/16 inch thick.
b. For signs larger than 20 sq. in., 1/8 inch thick.

4. Engraved legend with black letters on white face. Emergency panels shall have white letters on red face.
5. Minimum letter height shall be 3/4 inch (10 mm) unless otherwise indicated.
6. Permanent self-adhesive.
7. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

C. Device Plate Labels: Permanent self-adhesive backed, 3/8 inch (10 mm) wide, clear heavy-duty acrylic tape with machine printed 1/4 inch (6 mm) high black letters. Impression letters on plastic tape are not acceptable.

D. Underground Line Concrete Markers: 12 inches square by 4 inches thick concrete, chamfered top edges, arrows with stamped legend indicating route and type of underground line.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

E. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Self-Adhesive Identification Products: Clean surfaces before application using materials and methods recommended by manufacturer of identification device.

H. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

I. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

J. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer or load shedding.

M. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

N. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

X. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

Y. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized and plenum-rated cable ties.

Z. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized and plenum-rated cable ties.

AA. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized and plenum-rated cable ties.

BB. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on minimum 1-1/2-inch- high sign; where two lines of text are required, use signs minimum 2 inches high.

CC. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

DD. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

EE. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at both sides of penetrations of walls and floors, at 30-foot maximum intervals in straight runs, and at 15-foot maximum intervals in congested areas.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase. Locate at each load or terminal connection in control panels and panelboard gutters. Use self-adhesive wraparound labels to identify source, circuit number, and voltage of each set of conductors.

E. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation. Identify source, circuit number, and voltage of each set of conductors.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination. Handwritten lettering is not acceptable. For wires of different systems in common boxes, group each cable with its own system and identify each cable to indicate appropriate system.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation. Include wire number or terminal number from schematic, or interconnection diagrams on installation or shop drawings.

H. Motor Control Labels: Provide typed label inside each motor starter, adjustable frequency drive, etc., including those furnished by other divisions, identifying motor served, horsepower, voltage, phase, full-load current, code letter, and design letter.

I. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

J. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

K. Junction and Pull Box Identification: Stencil or neatly identify with permanent marker all junction and pull boxes as follows:

1.	Lighting and Power including panelboard names	-	208V, 240V circuit numbers enclosed
2.	Data	-	DAT
3.	Television	-	TV
4.	Sound Reinforcement	-	SR
5.	Paging	-	PA
6.	Intercom	-	IC
7.	Emergency	-	E (white letters on red background)

L. Empty and/or Spare Raceways: Install identification tag stamped to indicate conduit destination and future use, i.e., sound, telephone, electric, etc.

M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
1. Install underground-line warning tape for direct-buried cables and cables in raceways.

2. During construction, provide temporary identification of underground raceways and direct-buried cable routings by means of marker flags located directly above and along entire length of raceway and wiring.

N. Workspace Indication: Apply floor marking tape tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

   a. Power-transfer switches.
   b. Controls with external control power connections.

3. For equipment requiring workspace clearance according to NFPA 70, apply to door or cover of equipment, but not on flush panelboards and similar equipment in finished spaces, unless noted otherwise.

Q. Warning Labels for High Voltage Equipment and Boxes: Locate on entrance doors to each electrical room containing high voltage equipment, on each primary switch, on each unit substation, on each padmount transformer and on each junction box containing high voltage cable.

R. Arc Flash Warning Labeling: Self-adhesive labels.

1. Comply with NFPA 70E and ANSI Z535.4.
2. Comply with Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

S. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

T. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer load shedding.

U. Equipment Identification Labels:

1. Label all equipment.
2. Utilize unique designation that is consistent with drawings, wiring diagrams, schedules, and operation and maintenance manual. Include equipment type, e.g.: UNIT SUB, MCC, DP, SWBD, ATS, XFMR, PNL, BUSWAY, FIRE ALARM, PA, PAGING, ACCESS CONTROL, NURSE CALL, etc.
3. Verify all equipment names with Owner and Engineer prior to making labels.

4. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system.
5. Systems include power, lighting, control, communication, signal, monitoring, and alarm, unless equipment is provided with its own identification.
6. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Impression letters on plastic tape will not be allowed. Unless otherwise indicated, provide a single line of text with 3/4 inch-high letters on 1-1/2 inch-high label; where additional lines of text are required, increase label height proportionally.
7. Outdoor Equipment: Stenciled legend 4 inches high.
8. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
9. Equipment to Be Labeled, shall include, but not be limited to, the following:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    e. Busway.
    f. Emergency system boxes and enclosures.
    g. Enclosed switches.
    h. Enclosed circuit breakers.
    i. Enclosed controllers.
    j. Push-button stations.
    k. Contactors.
    l. Remote-controlled switches, dimmer modules, and control devices.
    m. Time switches.
    n. Power-generating units.
    o. Monitoring and control equipment.
    p. UPS equipment.
    q. Voice and data cable terminal equipment.
    r. Paging system equipment.
    s. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
    t. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

10. Identify equipment on inside of cover of flush panels and on outside of cover of surface panels as follows:

    a. Lighting and Power Panels (black letters on white background) - PANEL DESIGNATION (3/4 inch high letters), VOLTAGE (1/4 inch high letters), SOURCE PANEL FEEDING THIS PANEL AND OWNER’S ROOM NUMBER WHERE SOURCE PANEL IS LOCATED (1/4 inch high letters).

b. Communications Cabinets - TELEPHONE OR OTHER USAGE (paging, etc.).
c. Data Cabinets - DATA.
d. Emergency Panels (white letters on red background) - EMERGENCY PANEL DESIGNATION (3/4 inch high letters), VOLTAGE (1/4 inch high letters), SOURCE PANEL FEEDING THIS PANEL AND OWNER'S ROOM NUMBER WHERE SOURCE PANEL IS LOCATED (1/4 inch high letters).

11. Identify each main breaker or switch (primary and secondary) in all distribution equipment with laminated label similar to above.
12. Equip each branch device in all distribution panelboards, switchboards, motor control centers, busway, unit-substations, etc., with laminated label similar to above. Identify load served and location of load. Use identifications compatible with Owner's program. For adjustable-trip circuit breakers, identify trip setting.

    a. Identify all control devices, circuit breakers, disconnect switches, motor starters, contactors, time switches, test switches, etc, including those furnished by other divisions or with pre-purchased equipment, with equipment fed and Owner's room number where equipment is located, source panel or equipment feeding this device, and Owner's room number where source panel or equipment is located. Height of label may be decreased where mounting space for label is limited.

V. Panelboard Directories:

1. Equip each branch circuit panelboard with typewritten or computer generated directory accurately indicating Owner's room number and equipment name being served.
2. Use identifications compatible with Owner's program, and readily identifiable without removing directory from its holder.

W. Device Plate Identification
1. Engrave device plates of all receptacles on emergency electrical system with word "EMERGENCY" , and on isolated ground system with words "ISOL.GND"• . Separate nameplates secured to device plate are not acceptable.
2. Label device plates of all wall switches, receptacles, control stations, etc., indicating source, panel name, and circuit.

    a. Label device plates of all wall switches, control stations, volume controls, etc., with permanent adhesive indicating equipment controlled.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices and short-circuit current rating of all distribution equipment.

B. Based upon study results, select and furnish all distribution equipment, and set all protective devices, to provide the following:

1. Short-circuit current ratings equal to or greater than the available short-circuit current, as determined by this study, or equal to the interrupting rating shown in the specifications or on the Drawings, whichever is greater.
2. Coordination of the short-circuit protection per N.E.C. Article 240.12.
3. Protection from damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions per N.E.C. Article 240.4 and ICEA P-32-382.
4. Coordination of ground-fault protection for service and disconnecting means in healthcare facilities per N.E.C. Article 517.17B.
5. Selective coordination of all overcurrent protective devices for emergency systems and legally required standby systems per N.E.C. Articles 700.28 and 701.27.
6. Protection from damaging temperatures in transformers under overcurrent conditions.
7. Selective coordination of all overcurrent protective devices for more than one elevator supplied by a single feeder per N.E.C. Article 620.62.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following simultaneously with or prior to the distribution system protective devices submittals. Submittals may be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action concurrent with or prior to the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

3. Revised layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to selections of overcurrent protective devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum single- or three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility maximum available fault current and impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal power source throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a single- or three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Control panels.
3. Branch circuit panelboards.
4. Disconnect switches.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 LABELING

A. Label all new equipment and all equipment feeding new equipment with maximum available fault current per N.E.C. Article 110.24.

3.5 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

B. Based upon study results, select and furnish all distribution equipment, and set all protective devices, to provide the following:

1. Coordination of the short-circuit protection per N.E.C. Article 240.12.
2. Protection from damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions per N.E.C. Article 240.4 and ICEA P-32-382.
3. Coordination of ground-fault protection for service and disconnecting means in healthcare facilities per N.E.C. Article 517.17B.
4. Selective coordination of all overcurrent protective devices for emergency systems and legally required standby systems per N.E.C. Articles 700.28 and 701.27.
5. Protection from damaging temperatures in transformers under overcurrent conditions.
6. Selective coordination of all overcurrent protective devices for more than one elevator supplied by a single feeder per N.E.C. Article 620.62.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following simultaneously with or prior to the distribution system protective devices submittals. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

    1. Submit study report for action concurrent with or prior to the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

4. Revised layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to short-circuit current ratings and selections of overcurrent protective devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in operation, maintenance manuals, and the following:

1. The following parts from the Protective Device Coordination Study Report:

    1. One-line diagram.
    2. Protective device coordination study.
    3. Time-current coordination curves.

2. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

1. Arcing faults.
2. Simultaneous faults.
3. Explicit negative sequence.
4. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

    1. Phase and Ground Relays:

        1. Device tag.
        2. Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3. Recommendations on improved relaying systems, if applicable.

    2. Circuit Breakers:

        1. Adjustable pickups and time delays (long time, short time, ground).
        2. Adjustable time-current characteristic.
        3. Adjustable instantaneous pickup.
        4. Recommendations on improved trip systems, if applicable.

    3. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

    1. Power utility's overcurrent protective device.
    2. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    3. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.

4. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
5. Cables and conductors damage curves.
6. Ground-fault protective devices.
7. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

E. Study electrical distribution system from normal power source throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

1. Inrush current when first energized.
2. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
3. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

G. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

H. The calculations shall account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

I. Calculate short-circuit momentary and interrupting duties for a single- or three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Control panels.
3. Branch circuit panelboards.

J. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of panelboard bus bars to withstand short-circuit stresses.

3.3 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.4 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility maximum available fault current and impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Maximum demands from service meters.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
14. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

    1. Special load considerations, including starting inrush currents and frequent starting and stopping.
    2. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    3. Ratings, types, and settings of utility company's overcurrent protective devices.
    4. Special overcurrent protective device settings or types stipulated by utility company.
    5. Time-current-characteristic curves of devices indicated to be coordinated.
    6. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
    7. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
    8. Panelboards ampacity, and SCCR in amperes rms symmetrical.
    9. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.5 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Revise layouts for electrical cabinets that require adjustments due to changes in distribution equipment sizes related to short-circuit current ratings and selections of overcurrent protective devices.

D. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.6 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following simultaneously with or prior to the distribution system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action concurrent with or prior to the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of arc-flash study.

3. Revised layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to selections of overcurrent protective devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
2. Operation and Maintenance Procedures: Provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABEL

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum.
2. The maximum calculation shall assume a maximum contribution from the utility.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time.

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility maximum available fault current and impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
12. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Label all new equipment with its associated arc-flash hazard warning per N.E.C. Article 110.16.

B. Equipment to be labeled shall include, but not be limited to the following:

1. Electrical and Communication Cabinets.
2. Panelboards.
3. Disconnect switches.
4. Control panels.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Digital timer light switches.
4. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Contact Configuration: DPDT.
3. Contact Rating: 20-A ballast load, 120-/240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Programs: 2 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
7. Astronomic Time: All channels.
8. Automatic daylight savings time changeover.
9. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.

3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. Tyco Electronics Corporation; a TE Connectivity Ltd. company.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc , with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

2.3 DIGITAL TIMER LIGHT SWITCH

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.

1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for LED, and 1/4 horsepower at 120-V ac.
2. Integral relay for connection to BAS.
3. Voltage: Match the circuit voltage, or Dual voltage - 120 and 277 V.
4. Color: White.
5. Faceplate: Color matched to switch.

2.4 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a business of Emerson Network Power.
3. Eaton Corporation.

4. General Electric Company.
5. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch .

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

END OF SECTION 260923

SECTION 260943 - RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Lighting control relay panels.
2. Manual switches and cover plates.
3. Field-mounted signal sources.
4. Conductors and cables.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. Monitoring: Acquisition, processing, communication, and display of equipment status data, event and alarm signals, tabulated reports, and event logs.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and cover plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Operational documentation for software and firmware.

B. Shop Drawings: For each relay panel and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.

4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation in accordance with NECA 407.

1.7 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that components of standalone multipreset modular controls perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Two year(s) from date of Substantial Completion, for labor, materials, and equipment.
2. Follow-on Extended Warranty Period: Eight year(s) from date of Substantial Completion, for materials that failed because of transient voltage surges only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.

D. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc. – LiteKeeper LK8
2. Hubbell Control Solutions
3. Acuity Brands
4. Leviton Manufacturing Co., Inc.
5. Douglas Lighting Control.

B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.

C. Lighting Control Panel:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.

1. Timing Unit:

a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
c. 64 Time-Of-Day/holiday schedules for 365 day programming.
d. Schedule periods settable to the minute.
e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
f. 32 special date periods.

2. Sequencing Control with Override:

a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
d. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence.

3. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation, including accurate time of day and date.

E. Relays:

1. Electrically operated, electrically or mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 10 kA. Control must be three-wire, 24 V(ac).

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:

1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

2.3 FIELD-MOUNTED SIGNAL SOURCES

A. Indoor Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal must be compatible with the relays.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 16 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Twisted-Pair Data Cable: Category 5e.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panels in accordance with NECA 407.

B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING

A. Wiring Methods:

1. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
2. Conceal raceway and cables except in unfinished spaces.
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 INSTALLATION OF PANELS

A. Install panels and accessories in accordance with NECA 407.

B. Mount panel cabinet plumb and rigid without distortion of box.

C. Install filler plates in unused spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operational Test: After installing lighting control relay panel and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:

1. Lighting control panel will be considered defective if it does not pass tests and inspections.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's instructions.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 MAINTENANCE

A. Software and Firmware Service Agreement:

1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.

    a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260943

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Submit simultaneously with or after the Overcurrent Protective Device Short-Circuit, Coordination, and Arc-Flash Studies.
2. Include dimensioned plans, elevations, sections, and details.

3. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
4. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
5. Detail bus configuration, current, and voltage ratings.
6. Short-circuit current rating of panelboards and overcurrent protective devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, maintenance manuals, and the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard, unless otherwise noted.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush or Surface-mounted, as shown on Drawings, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

F. Phase, Neutral, and Ground Buses:

1. Material and Type: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.
    c. Sequence type bussing interval connections, bus structure and main lugs or main protective devices with current ratings shown on Drawings.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Standard Neutral: Full capacity, equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Split Bus: Vertical buses divided into individual vertical sections.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated bus ampacity and conductor sizes shown on Drawings, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices. Provide blank covers for all unused device spaces.

1. Percentage of Future Space Capacity: Ten 20 percent, unless indicated otherwise.

J. Panelboard Short-Circuit Current Rating: Fully rated as shown on Drawings, or as required by Overcurrent Protective Device Short-Circuit Study, to interrupt symmetrical short-circuit current available at terminals. Series-connected ratings are NOT allowed. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

K. Circuit Breakers: Provide all circuit breakers on project from one manufacturer unless not commercially available.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1, Type 2.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as shown on Drawings.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike. Provide two (2) keys with each panelboard.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; all panelboards keyed alike. Provide two (2) keys with each panelboard. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. Short circuit current ratings as shown on Drawings, but not less than 10,000 RMS symmetrical amperes for panelboards rated 240 V or less, and 14,000 RMS symmetrical amperes for panelboards rated above 240 V and less than or equal to 600 V.

H. Equal to QO type manufactured by Square D Company.

I. Standard Box Size: 5-3/4 inches (145 mm) deep, 20 inches (500 mm) wide.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents or as shown on Drawings, whichever is higher.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Common simultaneous trip for 2 and 3 pole breakers.
    d. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Circuit breakers having 400A or higher trips shall have electronic trip unit.
4. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or field-replicable electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

        1) Standard, High-range instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time delay adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

5. Circuit breakers having 1000 amp or higher trip shall be UL listed/labeled for operation at 100 percent of amp rating.
6. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
7. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
8. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
10. Subfeed Circuit Breakers: Vertically mounted.
11. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Individually insulated, braced and protected connectors.
    c. Breaker handle indicates tripped status.
    d. UL listed for reverse connection without restrictive line or load ratings.
    e. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    f. Application Listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment.

g. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
h. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system.
i. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
j. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
k. Rating Plugs: Three-pole breakers with ampere ratings greater than 400 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
l. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
m. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
n. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
o. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices, prohibiting upstream devices from tripping when downstream device senses and trips from ground fault.
p. Multipole units enclosed in a single housing with a single handle orfactory assembled to operate as a single unit.
q. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
r. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD, horsepower rated, quick-make, quick-break; clips for Class R rejection fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.
b. Short circuit current rating of 200,000 RMS symmetrical amperes (with fuses).
c. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
d. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards 60 inches or greater in height on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install panelboards less than 60 inches in height on wall.
3. Attach panelboard to the vertical finished or structural surface behind the panelboard.
4. Provide steel channel supports to bridge studs above and below panelboards in stud partitions.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount panelboards such that top of switch or breaker handle is located 6'-6" or less above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards in wet or damp locations, such as concrete basement walls, to steel slotted supports 1 1/4 inch in depth. Orient steel slotted supports vertically.

J. Mechanically bolt panelboards of more than one (1) section together.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Provide breaker locking devices as required by other sections of Division 26.

3.3 IDENTIFICATION

A. Conductors: Identify field-installed conductors, interconnecting wiring, and components; complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Branch-Circuit Panelboard Directories: Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations and equipment being served. Use identifications compatible with Owner's program and readily identifiable without removing directory from its holder. Obtain Owner's approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
2. Verify nameplate data and overcurrent protective device sizes and types match drawing and specification requirements.
3. Inspect physical and mechanical condition of equipment.
4. Verify required anchoring of equipment to floor and wall.
5. Verify all bolted connections meet manufacturer's recommended tightness.
6. Test ground-fault protection of equipment per NFPA 70.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.
5. Re-label affected equipment, devices, junction boxes, wiring, panelboard directories, etc. due to load reconnection and branch circuit number changes.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain panelboards, overcurrent protective devices, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262416

SECTION 26 27 16 – ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Outdoor communication and electrical free standing enclosures and accessories.

B. Related Sections:

1. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
2. Section 26 05 33 – Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

A. NECA Standard of Installation (National Electrical Contractors Association)

B. National Electrical Manufacturers Association:

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 4 – Terminal Blocks for Industrial Control Equipment and Systems.

C. NFPA 70 - National Electrical Code.

D. UL 50

1.03 SUBMITTALS

A. Product Data: Include the following for each enclosure type indicated:

1. Dimensions, knockout sizes and locations, technical data on features, and ratings.
2. Material type, gauge, and finish.
3. Installation requirements and related data.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Close-out Documents.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosures from a single manufacturer.

B. 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.

C. Comply with NFPA 70.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.06 EXTRA MATERIALS

A. Furnish two of each key.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Hubbell.
3. Or approved equal.

2.02 OUTDOOR ENCLOSURES (KIOSK)

A. Construction: Free-standing, 2 door NEMA 250 Type 4x enclosure fabricated from 12 gauge Type 304 stainless steel. Construction features to include:

1. Seams to be continuously welded and formed smooth, free of cracks, blow holes and other irregularities. All inside and outside edges of the cabinet shall be free of burrs.
2. Structural body stiffeners for added strength.
3. Corrosion Inhibitors.
4. Removable centerpost.
5. Heavy-duty stainless steel lifting eyes.
6. Stainless steel hardware.
7. 12 gauge back and side interior mounting panels with supports.
8. Accessory mounting channel provided in enclosure top.
9. Bonding provisions on doors and grounding studs on body.
10. Matte black, textured finish.

B. Doors: Overlap type double flanged doors with heavy-duty stainless steel continuous hinges. Construction features to include:

1. Heavy-duty 3-point latching system with stainless steel handle & padlock hasp.
2. Seamless neoprene gasket.
3. Heavy duty door stop, 90 degree stop.
4. Door shall be a minimum of 90% of the front surface area

C. Interior lighting: LED light strip mounted to enclosure top accessory channel.

1. LED fixtures to consist of 5 low voltage LED modules with 3 LEDs per module and 25W power supply.

a. GE Tetra MiniStrip HO #GEBSH50-1

2. Provide remote door switches to activate lights when either enclosure door opens.

D. Enclosure Dimensions: As shown on drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Securing install enclosure plumb on concrete foundation where indicated on drawings.

B. Install in accordance with NECA “Standard of Installation”.

3.02 CLEANING

A. Clean electrical parts to remove conductive and harmful materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch-up minor damage.

3.03 WARRANTY

A. Provide a 2 year warranty on the enclosure to be free of defects in material and workmanship.

B. Warranty period will commence on the date of final acceptance.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. SPD receptacles, 125 V, 20 A.
5. Twist-locking receptacles.
6. Toggle switches, 120/277 V, 20 A.
7. Digital timer light switches.
8. Wall-box dimmers.
9. Wall plates.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory White unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.
3. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain all wiring devices and associated wall plates on project from same manufacturer unless not commercially available.

2.2 STANDARD RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 USB RECEPTACLES

A. Tamper-Resistant Duplex and USB Charging Duplex Receptacles :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.

d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Revisions to UL 943, effective June 29, 2015, require GFCI receptacles to have an auto-monitoring or self-test function, denying power or providing visual and/or audible indication, and to have a repeatable reverse line-load mis-wire function, denying power to the receptacle at the initial installation and any subsequent re-installations.End of life provision, denying power to receptacle face, or indicating with visual or audible means that device must be replaced, when receptacle can no longer provide ground fault protection (as indicated by the inability to pass its internal self-test function).
7. Reverse line-load mis-wire, denying power to receptacle face if device is mis-wired, at initial installation or re-installations.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hubbell Incorporated; Wiring Device-Kellems.
   b. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. End of life provision, denying power to receptacle face, or indicating with visual or audible means that device must be replaced, when receptacle can no longer provide ground fault protection (as indicated by the inability to pass its internal self-test function).
7. Reverse line-load mis-wire, denying power to receptacle face if device is mis-wired, at initial installation or re-installations.
8. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. End of life provision, denying power to receptacle face, or indicating with visual or audible means that device must be replaced, when receptacle can no longer provide ground fault protection (as indicated by the inability to pass its internal self-test function).
7. Reverse line-load mis-wire, denying power to receptacle face if device is mis-wired, at initial installation or re-installations.
8. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Back and side wired.

3. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Back and side wired.

3. Standards: Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Comply with UL 20 and FS W-S-896.

D. Four-Way Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Back and side wired.
3. Standards: Comply with UL 20 and FS W-S-896.

E. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Illuminated when switch is on.
3. Standards: Comply with UL 20 and FS W-S-896.

F. Lighted Single-Pole Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Premise Wiring.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Handle illuminated when switch is off.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

G. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Factory-supplied key in lieu of switch handle.
3. Standards: Comply with UL 20 and FS W-S-896.

H. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: For use with mechanically held lighting contactors.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

I. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.6 TIMER LIGHT SWITCH

A. Digital Timer Light Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

2. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10 20-minute increments.

3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Integral relay for connection to BAS.

2.7 DIMMERS

A. Wall-Box Dimmers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Lutron Electronics Co., Inc.
    e. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider; with single-pole or three-way switching.
4. Standards: Comply with UL 1472.
5. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

    a. 600 W; dimmers shall require no derating when ganged with other devices.
6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.8 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices. Wall plates of same material shall match same finish and details. Where two-gang boxes are required for single-gang devices, provide special wall plates with device opening in one gang and second gang blank.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces and Flush Boxes in Unfinished Spaces: 0.10-inch thick, smooth, high-impact thermoplastic 0.035-inch- thick, satin-finished, Type 302 stainless steel, beveled type, with smooth rolled outer edge.
3. Material for Surface Boxes in Unfinished Spaces: Type 302 stainless steel.
4. Material for Damp Locations: Thermoplastic Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: Gasketed NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum thermoplastic with lockable cover. Provide spring-loaded gasketed doors for receptacles.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, except use mounting heights shown on Drawings, where indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. Use a torque screwdriver when a torque is recommended or required by manufacturer.
6. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
9. Mount switches vertically, plumb with building lines, and approximately 6 inches (151 mm) from door opening.
10. Mount receptacles vertically, unless otherwise noted on drawings, and at heights shown on drawings.
11. Secure switches and receptacles firmly to backbox, not to wall and/or coverplate, with device extending through coverplate on all sides.
12. Coordinate device mounting locations with architectural details.
13. Mount receptacles occupying same wall space as fintube radiation horizontally in toespace at 4 inches (105 mm) to top. Do not mount above fintube.
14. Install switches controlling 277 volt circuits in individual outlet boxes or in gang boxes with approved barriers between switches.
15. Provide G.F.C.I. outlet at each location shown on drawings. Do not use one G.F.C.I. outlet to protect downstream outlets.
16. Do not use common neutrals on dimmer circuits.
17. Install cover plates on all outlet boxes. Match plate configuration to devices within box.
18. Mount flush plates so all four (4) edges are in continuous contact with finished wall.
19. Install blank cover plates on all open outlet boxes.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left (neutral contact at top).

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Follow dimmer manufacturer's directions when ganging dimmers.
3. Verify that dimmers used for fan-speed control are listed for that application.
4. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas hospital-grade outletsfor the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

    a. Control circuits.
    b. Panelboards.
    c. Enclosed controllers.
    d. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.
4. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
3. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance, 601 to 6000 Amperes: Class L, time delay, 200,000 amperes RMS symmetrical interrupting rating.
2. Service Entrance, 1/10 to 600 Amperes: RK1, time delay, 300,000 amperes RMS symmetrical interrupting rating.
3. Feeders, 601 to 6000 Amperes: Class L, time delay, 300,000 amperes RMS symmetrical interrupting rating.
4. Feeders, 1/10 to 600 Amperes: Class RK1, time delay, 300,000 amperes RMS symmetrical interrupting rating.
5. Motor Branch Circuits, 1/10 to 600 Amperes: Class RK1, time delay, 300,000 amperes RMS symmetrical rating.
6. Large Motor Branch Circuits, 601 to 4000 Amperes: Class L, time delay, 300,000 amperes RMS symmetrical interrupting rating.
7. Other Branch Circuits: Class RK1, time delay.
8. Control Transformer Circuits: Class CC, time delay, control transformer duty.

3.3 INSTALLATION

A. Install fuses in each fusible device, including those furnished by others, after equipment is set in place. Arrange fuses so rating information is readable without removing fuse.

B. Replace all fuses that have opened during construction.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information (class, size, etc.) inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 263100 - PHOTOVOLTAIC SYSTEM PERFORMANCE REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. PV system description.
2. Manufactured PV units.
3. PV module framing.
4. PV array construction.
5. Inverters.
6. System overcurrent protection.
7. Mounting structures.

1.3 DEFINITIONS

A. ETFE: Ethylene tetrafluoroethylene.

B. FEP: Fluorinated ethylene propylene.

C. MPPT: Maximum power point tracking.

D. NABEP: North American Board of Certified Energy Practitioners.

E. PTC: PVUSA Test Conditions, 1000 W/m2, 1.5 air mass, 20°C air temperature, and 1 meter/sec. wind speed.

F. PV: Photovoltaic

G. PVUSA: Photovoltaics for Utility Systems Applications.

H. STC: Standard Test Conditions, 1000 W/m2, 1.5 air mass, and 25°C cell temperature.

I. Voc: Open circuit voltage.

J. Isc: Short circuit current.

1.4 ACTION SUBMITTALS

A. Experience: Submit resumes for individuals involved with the design and construction of the PV System. Submit references and summaries of five similar projects that these individuals have completed.

B. Product Data: For each type of component indicated below. Include rated capacities, operating characteristics, and furnished specialties and accessories. All product data submittals shall be submitted for review by Owner prior to purchasing any materials or equipment.

1. Solar modules
2. Grid tied inverters, including efficiency data
3. Racking system, including rail, clamps, brackets, and/or roof attachments.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. All shop drawings shall be submitted for review by Owner prior to purchasing any materials or equipment.

1. Dimensioned AutoCAD plan drawings of equipment including solar module array, inverters, disconnects, metering, and electrical conduit routing.
2. Provide AutoCAD drafted one-line wiring diagram of solar PV system indicating ratings of all modules and inverters, wire and conduit types and sizes, and disconnects.

D. Design Calculations

1. The following design calculations shall be performed by Contractor and submitted for review by Owner prior to purchasing any materials or equipment.

a. Electrical calculations, including string sizing, inverter selection, and voltage losses.
b. Structural calculations, including rail spans, wind, and snow loading, required ballast weights, and roof strength calculations.

E. Permitting and Agreements

1. The following permits and agreements shall be prepared by Contractor on behalf of the Owner. All approved permits and agreements shall be submitted for review by Owner prior to purchasing any materials or equipment.

a. Utility interconnection agreement.
b. Building permit.
c. Electrical permit.

F. As built drawings.

1. Dimensioned AutoCAD plan drawings of equipment including solar module array, inverters, disconnects, metering, and electrical routing.
2. Provide AutoCAD drafted one-line diagram of solar PV system indicating ratings of all modules and inverters, wire and conduit types and sizes, and disconnects.

1.5 INFORMATIONAL SUBMITTALS

A. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements. Include voltages and power output for each string. Measure and record solar intensity during testing. Include time, date, and weather conditions of test.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For PV system components to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified and trained in electrical safety as required by NFPA 70E.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
2. Installer must have PV Installer certification through NABCEP or applying for certification.

B. 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.

C. Comply with NFPA 70 and all applicable state and local codes.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver PV system in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover PV system components to provide protection from weather, dirt, dust, corrosive substances, and physical damage.

D. Handle and prepare PV system components for installation according to manufacturer’s recommendations.

1.9 COORDINATION

A. Coordinate metering and interconnection agreement with electric utility. Contractor shall pay all interconnection fees including the application review fee, engineering review fee, and distribution system study fee. Contractor shall submit all required forms to utility.

B. Coordinate all work affecting building’s roof with roofing manufacturer to ensure the roof’s warranty is maintained.

1.10 WARRANTY

A. Installer’s Warranty: Installer agrees to cover any defects of the PV system installation workmanship that fail in within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace PV system components, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Module Warranty Period from date of Substantial Completion:
   a. 5 years workmanship.
   b. 10 years 90% linear power output.
   c. 25 years 80% linear power output.
2. Inverter Warranty Period: 15 years from date of Substantial Completion.
3. Racking Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. This section includes general performance requirements that apply to installing a solar electric (PV) system for this project.

B. Contractor is the Designer of Record for this system. Contractor is required to provide a Structural PE (Professional Engineer) Stamp for the structural design and an Electrical PE Stamp for the overall system design.

C. Both the structural and electrical stamps are to be provided from experienced PV designers with at least 5 similar completed projects.

D. Contractor is required to have experience with at least 5 similar completed PV projects.

E. Product specifications included in this section are the Basis for Design. Design substitutions shall meet the minimum performance requirements defined in this section. Contractor shall select number of inverters and perform string sizing.

F. Related Work and Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

G. Incentive Paperwork: Contractor to provide support with Owner’s application for Focus on Energy incentives.

2.2 SOLAR MODULES

A. Manufacturers: Subject to compliance with performance requirements, provide products by one of the following:

1. Canadian Solar
2. Hanwha Q-cells.
3. Heliene.

4. REC.
5. Trina Solar

B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 00.

C. Capacities and Characteristics:

1. All modules shall be from a single manufacturer.
2. Power Output Ratings: STC rated power of at least 300 watts if 60 or 120 cell and at least 360 watts if 72 or 144 cell.
3. DC Array size of at least 2 KW.
4. Power tolerance of less than 5% variation (maximum minus minimum). Minimum tolerance of -0%.
5. Nameplates: To identify electrical characteristics, manufacturer's name and address, and model and serial number of components.
6. Module efficiency: minimum 18.00%
7. 60, 72, 120, or 144 cell.

D. Materials and construction:

1. Monocrystalline or Polycrystalline.
2. Junction box with bypass diodes.
3. Output Connections: Factory wired separate positive and negative leads sized per division 26 wire requirements with locking quick disconnects, rated for use in direct sunlight. Shall meet all requirements of NEC article 690.33.
4. Anodized aluminum frame with drainage holes and grounding holes.
5. Operating temperature range of -40°C to +85°C.
6. Withstand 1” diameter hail at 50 mph without damage.
7. Load rated at 5400 Pa (113 psf) when used with two rail system.

2.3 INVERTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fronius.
2. SMA.
3. Solar Edge.
4. Enphase.
5. Chilicon.

B. If an alternate product is proposed, bid is to document how the proposed solution is more cost effective to the owner. Follow substitution request procedure per 01 25 13.

C. Standards:

1. IEEE 1547.
2. UL 1741 – anti-islanding.

D. Electrical characteristics:

1. AC kW rating: Minimum DC-to-AC ratio of 1.2.
2. Output voltage: 240 VAC 1 phase.

3. Frequency: 60 Hz sine wave.
4. Input voltage: Coordinated with solar array.
5. Max Voc: Coordinated with solar array.
6. Max DC current: Coordinated with solar array.
7. Startup voltage: Coordinated with solar array.
8. Output power factor: Unity
9. DC to AC conversion efficiency: 97.5% CEC rated efficiency.
10. AC and DC rapid shutdown compliant with NEC 2017.

E. Features:

1. Transformerless design.
2. Forward facing DC disconnect.
3. DC side ground fault protection.
4. Inverter must limit power output to nameplate value. If connected to an array capable of producing more than the inverter's capacity, the inverter must limit the power without damage.
5. Maximum power point tracking over the range of voltages of the array, at the ambient temperatures of the site.
6. User navigable display.
7. LED status lights on enclosure.
8. Communication port for diagnostics and communication port for communication with multiple inverters and internet interface device.
9. NEMA 3R enclosure

2.4 PV SYSTEM WIRING

A. Type PV-WIRE, #10AWG, from array to combiner box, and where used as a jumper for connection between modules.

B. UV-Stabilized Cable Ties:

1. Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
2. Minimum Width: 3/16 inch (5 mm).
3. Tensile Strength at 73 °F (23 °C), According to ASTM D 638: 12,000 psi (82.7 MPa).
4. Temperature Range: -40 to +185 °F (-40 to +85 °C).
5. Color: Black.

C. Ampacity of PV source circuits shall be a minimum of 156% of the sum of parallel strings short circuit currents.

1. Shall be sized to limit voltage drop to 1.5% from array to inverter during full production at MPPT voltage at maximum ambient temperature.
2. Shall be in metallic conduit from combiner box, if installed, to inverter.

2.5 RACKING & ROOF ATTACHMENT & ROOF PENETRATIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Products for attached systems on flat roofs:

a. Roof attachment
   1) Anchor Products U-Anchor.
   2) Iron Ridge Flat Roof Attachment.
   3) OMG Roofing Products Power Grip Plus.
b. Racking
   1) Iron Ridge XR
   2) Unirac SM

2. Products for ballasted systems on flat roofs:

   a. Unirac RM10
   b. Ecolibrium Solar Ecofoot

3. Products for pitched roofs:

   a. Roof attachment
      1) Anchor Products U-Anchor.
      2) Iron Ridge Flat Roof Attachment.
      3) OMG Roofing Products Power Grip Plus.
      4) S-5 Clamps (for standing seam installations).
         a) Use S-5-U, S-5-S, or the required clamp for the specific roofing product.
         b) S-5 mini clamps are not acceptable.
      5) EcoFasten GreenFasten or QuickFoot (for composite shingle installations)
   b. Racking
      1) Iron Ridge XR
      2) Unirac SM

4. Products for pole mount arrays:

   a. MTSolar Top of Pole Mounts.
   b. Preformed Line Products Top of Pole Mounts.

5. Products for ground mount arrays:

   a. MTSolar Ground Mounts.
   b. Preformed Line Products Power Peak.
   c. Iron Ridge XR Ground Mount.
   d. Unirac GFT or ULA.

2.6 INTERNET BASED MONITORING

A. Provide standard package from inverter manufacturer and connect to the City Network. Coordinate with Owner. Contractor is required to test monitoring to confirm it is functioning.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of electrical connections. Verify actual locations of connections before module installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ARRAY REQUIREMENTS

A. Install modules on racking designed for solar (PV) modules.

B. Structural Performance: Installation shall withstand all local wind and snow loads, and all local building department requirements.

C. If applicable, slip sheet is to be used between ballasted racking and roof membrane.

D. All fastening hardware must be stainless steel.

E. All materials must be metallurgically compatible where different materials are in contact with each other.

F. Roof penetrations shall be made watertight using methods that are standard to the roofing industry, are approved by the roofing manufacturer, and that protect the warranty of the roof.

G. The modules shall be connected in arrays with the following characteristics:

1. The modules shall be installed only in the area outlined in Exhibit A.
2. Proposed alternate layout shall be submitted to CPM and approved prior to installation begins.
3. If needed, each array shall be provided with a combiner box.
4. PV module cables may be installed exposed where routed directly behind modules, but all cables shall be installed in a section of conduit where crossing part of the roof not under a module. Conduit running across roof shall be supported on roof using Cooper B-Line Dura-Blok or equivalent.
5. All PV module cables shall be installed in a neat and workmanship like manner. Excess wire shall be coiled and bundled neatly and supported securely in an area where they are not subject to environmental degradation, such as from wind, sun, and animals. Attach PV module cables to racking with zip-ties listed for use in direct sunlight.
6. Modules shall be connected in series and parallel to match voltage and current ratings of inverter, across all ambient temperatures common to site (-25°C to 40°C).

    a. Open circuit voltage of array on coldest day of year in full sunlight shall not exceed maximum operating voltage rating of inverter, modules, or any other equipment.
    b. Open circuit voltage on warmest day of year in morning sunlight conditions (200W/m2 irradiance) shall exceed inverter startup voltage. Voltage under operating MPPT conditions, minus any voltage drop over conductors, shall exceed minimum inverter input voltage.

c. Available short circuit current multiplied by 1.25 shall not exceed ratings for the inverter or any modules.
d. All series strings of modules shall have same performance characteristics.

3.3 ELECTRICAL INSTALLATION

A. Ground equipment according to Division 26.

1. Size grounding conductors per NEC articles 250 and 690.
2. All conductive equipment enclosures must be grounded.
3. All module frames must be grounded.

a. The removal of any module shall not interrupt a grounded conductor to another photovoltaic source circuit.

B. Install wiring, combiner boxes, conduit, disconnects, inverter, web-based monitoring hardware, sensors and other equipment according to Division 26.

1. Exception – If Division 26 specifies otherwise, All Solar Electric Conduit material is to be metallic.

C. Connect wiring according to Division 26.

3.4 IDENTIFICATION

A. Identify and label system components according to Division 26.

1. Provide a unique label for each inverter, PV output circuit, combiner box, PV Source circuit, and module. Labeling shall match labeling shown on as-built diagram and plan provided by contractor.

B. Provide all labeling required by NEC article 690, including, but not limited to:

1. Label disconnects capable of being energized from both directions as such.
2. Provide plaque at utility service disconnect per article 690.56B. Field verify exact location.
3. Label each photovoltaic disconnecting means per NEC article 690.53.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections as indicated below and prepare test reports. Correct any deficiencies.

1. Visually inspect all connections.
2. Visually inspect all supports.
3. Measure Voc of each individual string of modules under full sunlight.

a. Verify Voc of all strings are balanced.
b. Verify measured Voc against calculated Voc for the ambient temperature. Extrapolate Voc to temperatures expected at site, and verify they are within inverters ratings.

4. Measure Isc of each string of modules.
5. Verify correct operation of inverter.
6. Verify correct operation of complete system.
7. Replace any defective modules. Modules shall be replaced at contractor's expense.

3.6 DEMONSTRATION

A. Simulate power outage by interrupting normal source and demonstrate that system disconnects from utility.

B. Provide owner's maintenance personnel with minimum two-hour training session and in compliance with Div 1 Training Requirements.

1. Provide training on function of each piece of equipment.
2. Provide training on maintaining the system.
3. Explain means of disconnecting the system, and principals of operation and safety.

END OF SECTION 263100

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

I. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB France.
2. Advanced Protection Technologies Inc. (APT).
3. Eaton Corporation.
4. Emerson Electric Co.
5. GE Zenith Controls.
6. LEA International; Protection Technology Group.
7. Leviton Manufacturing Co., Inc.
8. PowerLogics, Inc.
9. Schneider Electric Industries SAS.
10. Siemens Industry, Inc.

2.2 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be at least 125 percent of the nominal system voltage.

2.3 SERVICE ENTRANCE SUPPRESSOR

A. SPDs: Comply with UL 1449, Type 2.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
d. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 150 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

G. SCCR: Equal or exceed 200 kA.

H. Inominal Rating: 20 kA.

2.4 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 2.

1. Include LED indicator lights for power and protection status.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Comply with UL 1283.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 700 V for 208Y/120 V.
3. Neutral to Ground: 700 V for 208Y/120 V.
4. Line to Line: 1200 V for 208Y/120 V

E. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.

2.5 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R, Type 4X.

2.6 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires with LED lamps and drivers.
2. Luminaire-mounted photoelectric relays.

B. Related Sections include the following:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260943 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
3. Section 265119 "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

H. NAAMM: National Association of Architectural Metal Manufacturers.

1.4 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Submit in collated and bound brochures, with fixture type clearly identified on each cut.
2. Include manufacturer and catalog number.
3. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
4. Details of attaching luminaires and accessories.
5. Details of installation and construction.
6. Luminaire materials.
7. Photometric data based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type, complete with indicated lamps, drivers or , and accessories. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project. Conform to IES LM-79 and IES LM-80.

    a. Testing Agency Certified Data: Photometric data shall be certified by a qualified independent testing agency.

8. Photoelectric relays.
9. LED drivers or ballasts, including energy-efficiency data.
10. Include lamp life, fixture output (delivered lumens), color temperature (CCT), color rendering (CRI), voltage, and energy-efficiency data (luminaire watts).
11. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
3. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

B. Warranties: Special warranties specified in this section.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

E. Provide luminaires from a single manufacturer for each luminaire type.

F. Each solid-state luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces of luminaires, mounting arms, etc., by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the manufacturers specified in the Lighting Fixture Legend on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

C. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint or anodizing applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color support materials.
   1. Color: As selected from manufacturer's standard catalog of colors.

M. LED LAMPS AND DRIVERS

1. CRI of minimum 80. CCT of 3500K unless noted otherwise.
2. L70 lamp life of 50,000.
3. Lamps dimmable from 100 percent to 10 of maximum light output.
4. Internal driver.
5. Nominal Operating Voltage: As shown on the Lighting Fixture Legend on Drawings.
6. Lamp Rating: Lamp marked for outdoor use.

N. SOURCE LIMITATIONS

1. Obtain Luminaires from single source from a single manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all fixtures delivered to jobsite prior to installation to ensure all specification requirements and shop drawing notes and comments have been incorporated by manufacturer. Installation of fixtures signifies Contractor's acceptance and approval of fixtures from manufacturer.

3.2 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming at night. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

END OF SECTION 265600

SECTION 321613.19 – DOCKING GUIDE STRIP

PART 1 - GENERAL

1.1 SUMMARY

A. Work of this Section includes the complete construction of all docking guide strips in the project. The construction includes providing and installing docking guide strips on all proposed BRT station platforms as identified on the Contract Drawings including but not limited to the backing boards, anchor bolts, and washers.
   1. Tapers shall be provided at the ends as shown on plans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product, in manufacturer's standard sizes.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For docking guide strips, to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost.

PART 2 - PRODUCTS

2.1 DOCKING GUIDE STRIP

A. Source Limitations: Obtain each type of docking guide strips, anchors, and fasteners from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Docking Guide Strip: Custom formulated, synthetic fender designed to reduce street curb damage at bus stops. Provide material with integral, consistent color, UV stabilized throughout the material.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Polymer Industries POLYSLICK Bus Curb-S or comparable product as approved by Architect.
   2. Material: Ultra High Molecular Weight Polyethylene blend with additives to protect it from ultraviolet degradation. Physical Characteristics:

Property	Method	Unit	Typical Value
Specific Gravity (Relative Hardness)	ASTM D 792	g/cm^3	0.932
Hardness	ASTM D 2240	Shore D	65
Tensile Break	ASTM D 638	psi	4,350
Elongation at Break	ASTM D 638	%	300
Abrasion	Internal	Steel=100	16
IZOD Impact			
Notched	ASTM D 256	ft.-lbs./in.	No Break
Double Notched	ASTM D 256A	ft.-lbs./in.	18
Linear Coefficient of Thermal Expansion	ASTM D 696	$°K^{-1}$	2×10^{-4}
Coefficient of Friction			
Static	ASTM D 1894	Unitless	0.2
Dynamic	ASTM D 1894	Unitless	0.15

   3. Color: Safety yellow.
   4. Provide backing boards, lock washers, and anchorages as recommended by the manufacturer and as shown on Drawings.
   5. Exposed edges shall have fillet or radius as follows:
      a. 1-inch at the top
      b. 1/4-inch at the bottom
      c. 1/2-inch on the ends
   6. Shapes and Sizes: As shown on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

B. Verify lines, levels, and dimensions before proceeding with work of this section.

C. Confirm acceptance of structural concrete prior to drilling anchorages.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Review reinforcing details to avoid drilling anchorages into steel.

B. Provide joint sealant where concrete is adjacent the top of the docking guide strip.

3.3 ANCHORING DOCKING GUIDE STRIPS

A. Docking guide strips shall be installed per the manufacturer’s recommendations.
   1. Special attention shall be made to the installation requirements regarding thermal expansion. Countersunk holes for attachment shall be drilled to accommodate the expansion.
   2. Lock washers and/or adhesives shall be installed per manufacturer’s recommendations.
   3. Five foot transitions at each end of the wheel guide shall be constructed so as to provide all curb edges as flush.

END OF SECTION 321613.19

ARCHITECTURAL SPECIAL PROVISIONS
Package 2

Madison Bus Rapid Transit

STATION NON-SHELTER

Final PS&E

ISSUE DATE:
October 5, 2022

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SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form that is part of web-based Project management software or acceptable to Architect.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
      d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
      e. Samples, where applicable or requested.

f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within five days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect

will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
b. Substitution request is fully documented and properly submitted.
c. Requested substitution will not adversely affect Contractor's construction schedule.
d. Requested substitution has received necessary approvals of authorities having jurisdiction.
e. Requested substitution is compatible with other portions of the Work.
f. Requested substitution has been coordinated with other portions of the Work.
g. Requested substitution provides specified warranty.
h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
b. Requested substitution does not require extensive revisions to the Contract Documents.
c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
d. Substitution request is fully documented and properly submitted.
e. Requested substitution will not adversely affect Contractor's construction schedule.
f. Requested substitution has received necessary approvals of authorities having jurisdiction.
g. Requested substitution is compatible with other portions of the Work.
h. Requested substitution has been coordinated with other portions of the Work.
i. Requested substitution provides specified warranty.
j. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
   1. General coordination procedures.
   2. Coordination drawings.
   3. RFIs.
   4. Digital project management procedures.
   5. Web-based Project management software package.
   6. Project meetings.

B. Related Requirements:
   1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
   2. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.2 DEFINITIONS

A. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.3 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.

15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
   1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow four days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
   1. The following Contractor-generated RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for approval of Contractor's means and methods.
      d. Requests for coordination information already indicated in the Contract Documents.
      e. Requests for adjustments in the Contract Time or the Contract Sum.
      f. Requests for interpretation of Architect's actions on submittals.
      g. Incomplete RFIs or inaccurately prepared RFIs.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI number, including RFIs that were returned without action or withdrawn.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

1.6 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
   1. Web-based Project management software includes, at a minimum, the following features:
      a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.

b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
c. Document workflow planning, allowing customization of workflow between project entities.
d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
e. Track status of each Project communication in real time, and log time and date when responses are provided.
f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
g. Processing and tracking of payment applications.
h. Processing and tracking of contract modifications.
i. Creating and distributing meeting minutes.
j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
k. Management of construction progress photographs.
l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Architect, and Architect's consultants.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.

B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.7 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of four days prior to meeting. Provide meeting location or virtual meeting weblinks.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these

meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
        1) Review schedule for next period.
    b. Review present and future needs of each entity present, including the following:
        1) Interface requirements.
        2) Sequence of operations.
        3) Status of submittals.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site use.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of Proposal Requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittal schedule requirements.
   2. Administrative and procedural requirements for submittals.

B. Related Requirements:
   1. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
   2. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
   1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
   2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
      a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
   4. Format: Arrange the following information in a tabular format:
      a. Scheduled date for first submittal.

b. Specification Section number and title.
c. Submittal Category: Action; informational.
d. Name of subcontractor.
e. Description of the Work covered.
f. Scheduled date for Architect's final release or approval.
g. Scheduled dates for purchasing.
h. Scheduled date of fabrication.
i. Scheduled dates for installation.
j. Activity or event number.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:
1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Paper Submittals:
1. Paper Submittals are permitted for physical samples only.
2. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
3. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
4. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.

5. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using transmittal form as approved by Architect.

E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

F. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
a. If web-based project management software is not used:
b. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
2. Paper: Prepare submittals in paper form and deliver to Architect.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
   3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's catalog cuts.
      b. Manufacturer's product specifications.
      c. Standard color charts.
      d. Statement of compliance with specified referenced standards.
      e. Testing by recognized testing agency.
      f. Application of testing agency labels and seals.
      g. Notation of coordination requirements.
      h. Availability and delivery time information.
   4. For equipment, include the following in addition to the above, as applicable:
      a. Wiring diagrams that show factory-installed wiring.
      b. Printed performance curves.
      c. Operational range diagrams.
      d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
   5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
   1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
   2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
      a. Project name and submittal number.
      b. Generic description of Sample.
      c. Product name and name of manufacturer.
      d. Sample source.
      e. Number and title of applicable Specification Section.
      f. Specification paragraph number and generic name of each item.
   3. Samples shall be submitted in both digitally and physical submittals as follows:
      a. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
      b. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
      c. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
   4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
      a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
      b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
   5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
      a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
   6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
      a. Number of Samples: Submit three sets of Samples. Architect will retain one Sample sets; remainder will be returned.
         1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
         2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
   1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
   2. Manufacturer and product name, and model number if applicable.
   3. Number and name of room or space.
   4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:
   1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
   2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
   3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
   4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
   5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
   6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:
   1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
   2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
   3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
   4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed

before installation of product, for compliance with performance requirements in the Contract Documents.

5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
    1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
    1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
    1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S REVIEW

A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required.
   1. Digital Submittals: Architect will indicate, via markup on each submittal, the appropriate action, as follows:
      a. Conforms As Is: Where submittals are marked "Conforms As Is," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
      b. Conforms As Noted: When submittals are marked "Confirms As Noted," that part of the Work covered by the submittal may proceed provided it complies with both the Architect's notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
      c. When submittal is marked "Does Not Conform;" or "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise and prepare a new submittal in accordance with the Architect's notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals marked as indicated above to be used at the Project site, or elsewhere where construction is in progress.
   2. Paper Submittals: Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
      a. Conforms As Is: Where submittals are marked "Conforms As Is," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
      b. Conforms As Noted: When submittals are marked "Confirms As Noted," that part of the Work covered by the submittal may proceed provided it complies with both the Architect's notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
      c. When submittal is marked "Does Not Conform;" or "Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise and prepare a new submittal in accordance with the Architect's notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals marked as indicated above to be used at the Project site, or elsewhere where construction is in progress.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Architect will discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
   1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency

qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.3 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Contractor's quality-control personnel.

B. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

E. Reports: Prepare and submit certified written reports and documents as specified.

F. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.6 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, telephone number, and email address of technical representative making report.
   2. Statement on condition of substrates and their acceptability for installation of product.
   3. Statement that products at Project site comply with requirements.
   4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
   5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   6. Statement of whether conditions, products, and installation will affect warranty.
   7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
   1. Name, address, telephone number, and email address of factory-authorized service representative making report.
   2. Statement that equipment complies with requirements.
   3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
   4. Statement of whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

1.7 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
   1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
   1. Provide test specimens representative of proposed products and construction.
   2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   3. Provide sizes and configurations of test assemblies to adequately demonstrate capability of products to comply with performance requirements.
   4. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

1.8 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
   1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
   2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
   1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Engage a qualified testing agency to perform quality-control services.
   a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's and authorities' having jurisdiction reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
   3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
   1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that

does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
   1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
   2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
   1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
   2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
      a. Name of product and manufacturer.
      b. Model and serial number.
      c. Capacity.
      d. Speed.
      e. Ratings.
   3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:
   1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
   2. Store products to allow for inspection and measurement of quantity or counting of units.
   3. Store materials in a manner that will not endanger Project structure.
   4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
   5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   7. Protect stored products from damage and liquids from freezing.
   8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
   a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following

conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
   1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
   2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
   1. Construction layout.
   2. Installation of the Work.
   3. Cutting and patching.
   4. Progress cleaning.
   5. Starting and adjusting.
   6. Protection of installed construction.
   7. Correction of the Work.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 QUALITY ASSURANCE

A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
   1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
   2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
   3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
   4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner

that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

C. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

D. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.4 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb, and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.5 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Temporary Support: Provide temporary support of Work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
   4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
   5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
   6. Proceed with patching after construction operations requiring cutting are complete.

E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
   1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.

F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.6 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Remove waste materials at the end of each day.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
      a. Use containers intended for holding waste materials of type to be stored.
   4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with City’s waste disposal requirements.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.8 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.9 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.

1.2 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
      a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
   4. Submit testing, adjusting, and balancing records.
   5. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Complete startup and testing of systems and equipment.
   2. Perform preventive maintenance on equipment used prior to Substantial Completion.
   3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
   4. Terminate and remove temporary facilities from Project site, along with construction tools and similar elements.
   5. Complete final cleaning requirements.
   6. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
   1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed

and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
2. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Architect.
   d. Name of Contractor.
   e. Page number.
3. Submit list of incomplete items in one of the following formats:
   a. MS Excel Electronic File: Architect will return annotated file.
   b. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect or by uploading to web-based project software site.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
      a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Remove snow and ice to provide safe access.
      f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces.
      g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      h. Clean transparent materials, including glass. Remove glazing compounds and other noticeable, vision-obscuring materials.
      i. Remove labels that are not permanent.
      j. Wipe surfaces of electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
      k. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
      l. Clean strainers.
      m. Leave Project clean and ready for occupancy.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

1.2 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Form ties.
4. Form-release agent.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 RELATED MATERIALS

A. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

B. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

C. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

D. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

E. Do not use rust-stained, steel, form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips.
2. Use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

J. Form openings, chases, offsets, sinkages, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.

K. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
3. Place joints perpendicular to main reinforcement.

L. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Clean embedded items immediately prior to concrete placement.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of Architect.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars:

1. Steel Bars: ASTM A615, Grade 60, deformed bars.
2. Epoxy Coating: ASTM A775 with less than 2 percent damaged coating in each 12-inch bar length.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced.

C. Steel Tie Wire: ASTM A1064, annealed steel, not less than 0.0508 inch in diameter.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Stagger splices in accordance with ACI 318.
2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

    a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
6. Curing materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.

3. Durability exposure class.
4. Maximum w/cm.
5. Slump limit.
6. Air content.
7. Nominal maximum aggregate size.
8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
9. Intended placement method.
10. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Bonding agents.
5. Adhesives.
6. Joint-filler strips.

B. Material Test Reports: For the following, from a qualified testing agency:

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Aggregates.
5. Admixtures.

C. Preconstruction Test Reports: For each mix design.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.6 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

2.3 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F: Black.
b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
c. Ambient Temperature Above 85 deg F: White.

D. Water: Potable or complying with ASTM C1602/C1602M.

E. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

F. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

2.4 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.5 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Total of Fly Ash or Other Pozzolans, and Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.6 CONCRETE MIXTURES

A. Class A: Normal-weight concrete used for footings, foundation walls, and platforms.

1. Exposure Class: ACI 318 F3.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.

B. Class B: Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 F0.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.4 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of slabs.
3. Unless otherwise indicated on Drawings, locate vertical joints in walls near corners, and in concealed locations where possible.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as foundation walls and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement and embedded items is complete and that required inspections are completed.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. Deposit concrete to avoid segregation.
2. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
3. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete slabs in a checkerboard sequence.

2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.6 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view.

B. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:

        1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Architect before application.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.9 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.

2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces.
2. If forms remain during curing period, moist cure after loosening forms.
3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Curing Compound:

        1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
        2) Recoat areas subjected to heavy rainfall within three hours after initial application.
        3) Maintain continuity of coating, and repair damage during curing period.
        4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

    a. Limit cut depth to 3/4 inch.
    b. Make edges of cuts perpendicular to concrete surface.
    c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    d. Fill and compact with patching mortar before bonding agent has dried.
    e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.

    a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
    b. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

    a. Correct low and high areas.
    b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.

    a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to remain exposed with repair topping.

a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
d. Place, compact, and finish to blend with adjacent finished concrete.
e. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
b. Dampen cleaned concrete surfaces and apply bonding agent.
c. Place patching mortar before bonding agent has dried.
d. Compact patching mortar and finish to match adjacent concrete.
e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

a. Test reports to include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:

1) Project name.

2) Name of testing agency.
3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
4) Name of concrete manufacturer.
5) Date and time of inspection, sampling, and field testing.
6) Date and time of concrete placement.
7) Location in Work of concrete represented by samples.
8) Date and time sample was obtained.
9) Truck and batch ticket numbers.
10) Design compressive strength at 28 days.
11) Concrete mixture designation, proportions, and materials.
12) Field test results.
13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Batch Plant Inspections: On a random basis, as determined by Architect.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231 pressure method, for normal-weight concrete.

a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31:
    a. Cast, initial cure, and field cure four standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.
    a. Test one field-cured specimen at seven days and one set of two specimens at 28 days.
    b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive strength test value is less than 90 percent of specified compressive strength.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests:

    a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.13 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.

END OF SECTION 033000

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Lintels.
3. Mortar and grout materials.
4. Reinforcement.
5. Ties and anchors.
6. Embedded flashing.
7. Accessories.
8. Mortar and grout mixes.

B. Products Installed but not Furnished under This Section:
1. Steel lintels in unit masonry.
2. Steel shelf angles for supporting unit masonry.
3. Cavity wall insulation.

C. Related Requirements:
1. Section 072100 "Thermal Insulation" for cavity wall insulation.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:
1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315R. Indicate elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:
1. Decorative CMUs, in the form of small-scale units.

2. Colored mortar.
3. Weep/cavity vents.

D. Samples for Verification: For each type and color of the following:
1. Decorative CMUs.
2. Colored mortar. Make Samples using same sand and mortar ingredients to be used on Project.
3. Weep/cavity vents.
4. Cavity drainage material.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of the following:
1. Masonry units.
a. Include data on material properties.
b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

B. Qualification Statements: For testing agency.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. Installers: All masonry flashing installers must complete the International Masonry Institute Flashing Upgrade training course.

2. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

B. Concrete masonry design must follow the recommendations of the National Concrete Masonry Association contained in the publication, TEK Manual for Concrete Masonry Design and Construction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches (610 mm) down both sides of walls, and hold cover securely in place.
   2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (610 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain exposed masonry units and cementitious mortar components from single source.

B. For exposed masonry units and cementitious mortar components, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602.
   2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 ft. (6 m) vertically and horizontally of a walking surface.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide bullnose units for outside corners at door frames unless otherwise indicated.

B. CMUs: ASTM C90, normal weight.
   1. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less than nominal dimensions.

C. Decorative CMUs: ASTM C90, normal weight.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Westbrook Concrete Block Ground Face Concrete Masonry with Pozzotive Unit or comparable product by manufacturer approved by Architect.
   2. Sizes: 4 inches by 8 inches by 16 inches.
   3. Water Repellency: Units shall be manufactured with a water repellent admixture equal to Dry Block, a product of the Grace Construction Products, in sufficient amount to comply with the manufacturer’s recommendation.
   4. Recycled Content: Units will be manufactured with Pozzotive, a high performance Supplementary Cementitious Material, made from 100% recycled post-consumer glass. Pozzotive replaces up to 30% of the Portland cement used in the manufacture of Westbrook concrete masonry units.
   5. Pattern and Texture: Ground Face
   6. Colors: To be selected by Architect from manufacturer’s full range.

D. Decorative CMUs: ASTM C90, normal weight.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Westbrook Concrete Block WESTBRICKS Ground Face with Pozzotive Unit or comparable product by manufacturer approved by Architect.
   2. Sizes: 4 inches by 4 inches by 16 inches.
   3. Water Repellency: Units shall be manufactured with a water repellent admixture equal to Dry Block, a product of the Grace Construction Products, in sufficient amount to comply with the manufacturer’s recommendation.
   4. Recycled Content: Units will be manufactured with Pozzotive, a high performance Supplementary Cementitious Material, made from 100% recycled post-consumer glass. Pozzotive replaces up to 30% of the Portland cement used in the manufacture of Westbrook concrete masonry units.
   5. Pattern and Texture: Ground Face
   6. Colors: To be selected by Architect from manufacturer’s full range.

2.5 LINTELS

A. Solid Concrete Masonry Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength of not less than that of CMUs.

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars

placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

C. Offset Angle Supports: Steel plate brackets anchored to structure, allowing continuous insulation behind shelf angle supporting veneer. Component and anchor size and spacing engineered by manufacturer.
   1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
   1. Alkali content will not be more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Cement: ASTM C1329/C1329M.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Aggregate for Mortar: ASTM C144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch (6.4 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C404.

I. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60 (Grade 420).

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-

mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
5. Wire Size for Veneer Ties: 0.148-inch (3.77-mm) diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches (406 mm) o.c.
7. Provide in lengths of not less than 10 ft. (3 m), with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Multiwythe Masonry:
1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches (102 mm) wide, plus two side rods at each wythe of masonry 4 inches (102 mm) wide or less.

2.8 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches (38 mm) into veneer but with at least a 5/8-inch (16-mm) cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
2. Stainless Steel Wire: ASTM A580/A580M, Type 304.
3. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.
4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
5. Stainless Steel Bars: ASTM A276 or ASTM A666, Type 304.

C. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (10-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf (445 N) load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch (1.6 mm).
2. Fabricate wire ties from 0.187-inch- (4.76-mm-) diameter, stainless steel wire unless otherwise indicated.
3. Masonry-Veneer Anchors, Thermally-Broken Veneer tie for CMU construction: Anchors to include washer at face of insulation and air barrier, and design to decrease thermal transfer through the rigid insulation.
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1) Heckmann Building Products
2) Hohmann & Barnard, Inc.
3) Wire-Bond.

2.9 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
   1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 316, 0.016 inch (0.40 mm) thick.
   2. Fabricate continuous flashings in sections 96 inches (2438 mm) long minimum, but not exceeding 12 ft. (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
   3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with sawtooth ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
   4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
   5. Solder metal items at corners.

B. Flexible Flashing: Use one of the following unless otherwise indicated:
   1. Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2-mil (0.05-mm) of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric, to produce an overall thickness of 40-mil (1.0-mm).
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hohmann & Barnard, Inc.
         2) Wire-Bond.
   2. Self-Adhering, Stainless Steel Fabric Flashing: Composite, flashing product consisting of 2 mil (0.05 mm) of Type 304 stainless steel sheet, bonded to a layer of polymeric fabric with a permanent, clear adhesive.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hohmann & Barnard, Inc.
         2) Wire-Bond.
      b. Applications: Use 10-mil- (0.25-mm-) thick flashing at windows, doors, and small wall penetrations; not at base of walls. Use 40-mil- (1.0-mm-) thick flashing at base of walls.
   3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mil (1.0 mm).
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Advanced Building Products Inc.
         2) GCP Applied Technologies Inc.
         3) Heckmann Building Products, Inc.
         4) Hohmann & Barnard, Inc.
         5) W. R. Meadows, Inc.
         6) Wire-Bond.
      b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
   4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 40 mil (1.0 mm).

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1) GCP Applied Technologies Inc.
   2) Wire-Bond.
b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Stainless steel bars 1/8 inch by 1 inch (3.2 mm by 25 mm).

2.10 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vents: Use one of the following unless otherwise indicated:
1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3.2 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity and 16 inches (406 mm) high, with dovetail-shaped notches or dimpled surface that prevent clogging with mortar droppings.

F. Masonry Veneer Thermal Break: Provide cellular glass structural insulating blocks (SIB) beneath masonry veneer as shown.
1. High-compressive strength, not less than 304 psi.
2. Equal to Owens Corning FOAMGLAS PERINSUL SIB.
3. Thickness: Refer to Drawings.

G. Proprietary Acidic Masonry Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
   1. Basis-of-Design for Exterior Mortar: Westbrook Type S Mortar Premix
      a. Single component product, consisting of Type S Masonry Cement (ASTM C-91) and finely graded Mason Sand (ASTM C-144), scientifically blended to a uniform mixture. Meets and exceeds the requirements of ASTM C-387 and ASTM C-270, Type S.
      b. Colors: To be selected by Architect from manufacturer’s full range.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For exterior masonry, use Type S.
   2. For interior nonload-bearing partitions, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.1.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
   3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch (13 mm) or minus 1/4 inch (6.4 mm).
   2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (13 mm).
   3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6.4 mm) in a story height or 1/2 inch (13 mm) total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.
   3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft. (3.2 mm in 3 m), 1/4 inch in 20 ft. (6.4 mm in 6 m), or 1/2-inch (13-mm) maximum.

5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), 3/8 inch in 20 ft. (10 mm in 6 m), or 1/2-inch (13-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 ft. (6.4 mm in 3 m), or 1/2-inch (13-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.6 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm), with a maximum thickness limited to 1/2 inch (13 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3.2 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (10 mm) or minus 1/4 inch (6.4 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3.2 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3.2 mm).
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.6 mm) from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches (102 mm). Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch (102-mm) horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, and remove loose masonry units and mortar.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches (610 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors, and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1219 mm) o.c. unless otherwise indicated.
   3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.

3.5 MORTAR BEDDING AND JOINTING

A. Lay CMUs as follows:
   1. Bed face shells in mortar and make head joints of depth equal to bed joints.
   2. Bed webs in mortar in all courses of piers, columns, and pilasters.
   3. Bed webs in mortar in grouted masonry, including starting course on footings.
   4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
   5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush where indicated to receive waterproofing or air barriers unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using bonding system indicated on Drawings.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch (10 mm) thick. Trowel face of parge coat smooth.

D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (305 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as indicated.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (152 mm).
   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   1. Provide an open space not less than shown on Drawings between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (914 mm) o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

C. Provide horizontal, pressure-relieving joints by either leaving an airspace or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch (10 mm).
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide masonry lintels where indicated and where openings of more than 24 inches (610 mm) for block-size units are indicated without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (203 mm) at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install reglets and nailers for flashing and other related construction where they are indicated to be built into masonry.

D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 24 inches (610 mm) o.c. unless otherwise indicated.

E. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (51 mm), to maintain drainage.
1. Fill cavities full height by placing pea gravel in cavities as masonry is laid, so that at any point, masonry does not extend more than 24 inches (610 mm) above top of pea gravel.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Accessories" Article.

G. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

3.12 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches (1524 mm).

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140/C140M for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.
   6. Where required by manufacturer. clean masonry with a proprietary acidic masonry cleaner applied according to manufacturer's written instructions.

END OF SECTION 042000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 099600 “High Performance Coatings.”

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Forged-steel hardware.
6. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Connection designs have been completed and connections indicated on the Drawings.

C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992.

B. Channels, Angles, S-Shapes: ASTM A36.

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B structural tubing.

E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Nuts: ASTM A563 hex carbon steel.
2. Plate Washers: ASTM A36 carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain.

2.5 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6 and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Product Certificates: For each type of steel deck.

B. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

2.2 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33 zinc coating.

2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

2.3 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and level recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

I. Galvanizing Repair Paint: ASTM A780.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI RD; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.

3.2 INSTALLATION OF ROOF DECK

A. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

C. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

D. Miscellaneous Roof-Deck Accessories: Install finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive in accordance with manufacturer's written instructions to ensure complete closure.

3.3 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780 and manufacturer's written instructions.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall and soffit framing.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

   1. Cold-formed steel framing materials.
   2. Exterior non-load-bearing wall and soffit framing.
   3. Power-actuated anchors.

B. Shop Drawings:

   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1, "Structural Welding Code - Steel."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing complies with AISI S200 and ASTM C955, Section 8.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with AISI S200 and ASTM C955, Section 8 for conditions indicated.

B. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST50H.
2. Coating: G90 or equivalent.

2.3 EXTERIOR NON-LOAD-BEARING WALL AND SOFFIT FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: As indicated.
2. Flange Width: 1-5/8 inches.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.2 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL AND SOFFIT FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Install horizontal bridging in walls and soffits, spaced as indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

E. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall or soffit framing system.

3.3 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error is not to exceed minimum fastening requirements of sheathing or other finishing materials.

END OF SECTION 054000

SECTION 057000 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Decorative metal exterior halo fabrication with integral lighting.

1.2 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative metal.
   1. Include plans, elevations, component details, and attachment details.
   2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
   3. Show locations of electrical service connections.
   4. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals: For decorative metal fabrications including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples for Verification: For each type of exposed finish.
   1. Sections of linear shapes.
   2. Samples of joints showing quality of workmanship and color matching of materials.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator, delegated design engineer, and organic-coating applicator.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings, of type indicated, to aluminum extrusions and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

D. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
   1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design decorative metal fabrications and building attachements.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Use materials with smooth, flat surfaces unless otherwise indicated. Use materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.3 ALUMINUM

A. Fabricate products from alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Bars and Shapes: ASTM B221 (ASTM B221M), Alloy 6063-T5/T52.

C. Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

D. Tubing: ASTM B210 (ASTM B210M), Alloy 6063-T832.

E. Plate and Sheet: ASTM B209 (ASTM B209M), Alloy 3003-H14.

F. Forgings: ASTM B247 (ASTM B247M), Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

2.4 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Aluminum Items: Aluminum or Type 304 stainless steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.

2.5 MISCELLANEOUS MATERIALS

A. Lighting Fixture: Refer to Drawings and Division 26 specifications.

B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly.
1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.
3. Use connections that maintain structural value of joined pieces.

B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

D. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

G. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: Match RAL 9011 Graphite Black.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Verify that electrical service is correctly sized and located.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

F. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
   1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood products.
   2. Wood-preservative-treated lumber.

B. Related Requirements:
   1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:
   1. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
   3. Dress lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, Use categories as follows:
   1. UC3A (Commodity Specification A): Coated sawn products in exterior construction not in contact with ground but exposed to all weather cycles including intermittent wetting. Include the following items:
      a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   3. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

2.3 MISCELLANEOUS LUMBER

A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

2.4 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in ICC's International Building Code (IBC).
   2. ICC-ES evaluation report for fastener.

I. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.

J. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach wood roofing nailers securely to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with ANSI/SPRI ED-1, Tables A6 and A7.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Parapet sheathing.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Parapet sheathing.

B. Product Data Submittals: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

C. Shop Drawings:
   1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
   2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Certainteed; SAINT-GOBAIN.
      b. Continental Building Products Inc.
      c. Gold Bond Building Products, LLC provided by National Gypsum Company.
      d. USG Corporation.
   2. Type and Thickness: Type X, 5/8 inch (15.9 mm) thick.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
   1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
   2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
   1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches (50 mm) wide, 10 by 10 or 10 by 20 threads/inch (390 by 390 or 390 by 780 threads/m), of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
   2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF GYPSUM SHEATHING

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install panels with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
   3. Install panels with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Seal sheathing joints in accordance with sheathing manufacturer's written instructions.

END OF SECTION 061600

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Polyurethane waterproofing.
   2. Insulation drainage panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review waterproofing requirements including, but not limited to, the following:
      a. Surface preparation specified in other Sections.
      b. Minimum curing period.
      c. Forecasted weather conditions.
      d. Special details and sheet flashings.
      e. Repairs.
      f. Field quality control.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
   2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings:
   1. Indicate locations and extent of waterproofing.
   2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer.
   1. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
   2. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain waterproofing materials from single source and from single manufacturer.

2.2 POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C836/C836M and coal-tar free.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CETCO is a subsidiary of Minerals Technologies Inc.
      b. Carlisle Coatings & Waterproofing Inc.
      c. MAPEI Corporation.
      d. Master Builders Solutions.
      e. Neogard; Hempel Group.
      f. Tremco Incorporated.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended in writing by waterproofing manufacturer for intended use and compatible with one another and with waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated.

C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
1. Adhesive: Manufacturer's recommended contact adhesive.

D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; as specified in Section 079200 "Joint Sealants"; and as recommended by manufacturer for substrate and joint conditions.
1. Backer Rod: Closed-cell polyethylene foam.

2.4 INSULATION DRAINAGE PANELS

A. Unfaced, Wall-Insulation Drainage Panels, Type IV: Extruded-polystyrene board insulation in accordance with ASTM C578, 25 psi (173 kPa) minimum compressive strength; unfaced; fabricated with shiplap or channel edges and with one side having grooved drainage channels.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. DiversiFoam Products.
b. Insulfoam; Carlisle Construction Materials Company.
c. Owens Corning.
d. The Dow Chemical Company.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates in accordance with manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.
   1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate in accordance with ASTM D4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces in accordance with ASTM D4258.

E. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

3.3 PREPARATION AT TERMINATIONS, PENETRATIONS, AND CORNERS

A. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.

B. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate in accordance with waterproofing manufacturer's written instructions and to recommendations in ASTM C1471/C1471M. Before coating surfaces, remove dust and dirt from joints and cracks in accordance with ASTM D4258.
   1. Comply with ASTM C1193 for joint-sealant installation.
   2. Apply bond breaker on sealant surface, beneath preparation strip.
   3. Prime substrate along each side of joint and apply a single thickness of preparation strip at least 6 inches (150 mm) wide along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where required in accordance with waterproofing manufacturer's written instructions.
   1. Extend sheet flashings for 4 inches (100 mm) onto perpendicular surfaces and items penetrating substrate.

3.5 INSTALLATION OF WATERPROOFING

A. Apply waterproofing in accordance with manufacturer's written instructions and to recommendations in ASTM C1471/C1471M.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate unless otherwise instructed in writing by waterproofing manufacturer.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
   1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases and pinholes, with a dry film thickness of 90 mils (2.25 mm).
   2. Apply waterproofing to prepared wall terminations and vertical surfaces.
   3. Verify manufacturer's recommended wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).

E. Cure waterproofing, taking care to prevent contamination and damage during application and curing.

3.6 INSTALLATION OF INSULATION DRAINAGE PANELS

A. Install drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch (19 mm) of projections and penetrations.

B. On vertical surfaces, set insulation drainage panels in adhesive or tape applied in accordance with manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components and to furnish daily reports to Architect.

B. Waterproofing will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

END OF SECTION 071416

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cavity wall rigid insulation.
   2. Closed-cell spray polyurethane foam insulation.

B. Related Requirements:
   1. Section 071416 "Cold Fluid-Applied Waterproofing" for insulated drainage panels.
   2. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for insulation specified as part of roofing construction.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. Cavity wall rigid insulation.
   2. Closed-cell spray polyurethane foam insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
   1. For spray insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, and coverage area.
   2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than 25 and 450 when tested in accordance with ASTM E84.

B. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

C. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches (305 mm) and wider in width.

D. Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 CAVITY WALL RIGID INSULATION

A. Subject to compliance with the requirements, provide one of the following rigid insulation boards in the exterior cavity wall.

B. Graphite-Polystyrene Foam-Plastic Board, Type I: ASTM C578, Type I, 10-psi (69-kPa) minimum compressive strength; 4-perm (230-ng/Pa x s x sq. m) maximum vapor permeance at 1-inch (25.4-mm) thickness per ASTM E96/E96M.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF; Neopor GPS. or a comparable product by one of the following:
      a. Atlas Molded Products, a division of Atlas Roofing Corporation.
      b. Insulfoam; Carlisle Construction Materials Company.

C. Mineral-Wool Board Insulation, Types IA and IB, Unfaced: ASTM C612, Types IA and IB; passing ASTM E136 for combustion characteristics.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; JM CladStone Water & Fire Block or a comparable product by one of the following:
      a. Owens Corning.
      b. ROCKWOOL.
   2. Nominal Density: 6 lb/cu. ft. (96 kg/cu. m).

2.3 CLOSED-CELL SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Spray Polyurethane Foam: ASTM C1029, Type II, minimum density of 2.0 lb/cu. ft. and minimum aged R-value at 1-inch (25.4-mm) thickness of 7.0 deg F x h x sq. ft./Btu at 75 deg F.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; JM Corbond III or a comparable product by one of the following:
      a. Carlisle Spray Foam Insulation.
      b. Gaco; a brand of Firestone Building Products.
      c. Henry Company.

d. Master Builders Solutions.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

B. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation.

B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

A. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face and as recommended by manufacturer.
   1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.
   3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

B. Mineral-Wool Board Insulation: Install insulation fasteners 4 inches (100 mm) from each corner of board insulation, at center of board, and as recommended by manufacturer.
   1. Fit courses of insulation between masonry wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
   2. Press units firmly against inside substrates.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
   1. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vapor permeable air barriers.

1.2 DEFINITIONS

A. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

B. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.
   1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
   2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
   1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.
   1. Protect substrates from environmental conditions that affect air-barrier performance.
   2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier. Air-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested in accordance with ASTM E2357.

C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75 Pa) pressure difference; ASTM E2178.

D. Adhesion to Substrate: Minimum 30 lbf/sq. in. (207 kPa) when tested in accordance with ASTM D4541.

E. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

F. UV Resistance: Can be exposed to sunlight for 90 days in accordance with manufacturer's written instructions.

2.3 AIR BARRIERS, VAPOR PERMEABLE

A. Vapor-Permeable Air Barrier, Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness according to manufacturer's written instructions, over smooth, void-free substrates.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Carlisle Coatings & Waterproofing Inc.
      b. GE Construction Sealants; Momentive Performance Materials Inc.
      c. GCP Applied Technologies Inc.
      d. Henry Company.
      e. Master Builders Solutions.
      f. PROSOCO, Inc.
      g. Soprema, Inc.
      h. Sto Corp.
      i. The Dow Chemical Company.
      j. Tremco Incorporated.

B. Vapor Permeance: Minimum 5 perms (290 ng/Pa x s x sq. m); ASTM E96/E96M, Procedure A, Desiccant Method.

2.4 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid primer recommended for substrate by air-barrier material manufacturer.

C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
   3. Verify that substrates are visibly dry and free of moisture.
   4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

3.3 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches (75 mm) of coverage is achieved over each substrate.
   3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
   4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

F. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, transition strip.

G. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

H. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
   1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
   2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
   3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. Do not cover air barrier until it has been tested and inspected by testing agency.

C. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:
1. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate in accordance with ASTM E783 or ASTM E2357.
2. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate in accordance with ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.
1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with air-barrier manufacturer's written instructions.
   2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Thermoplastic polyolefin (TPO) roofing system.
2. Accessory roofing materials.
3. Substrate board.
4. Roof insulation.
5. Insulation accessories.

B. Related Requirements:
1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Thermoplastic polyolefin (TPO) roofing system.
   2. Accessory roofing materials.
   3. Substrate board.
   4. Roof insulation.
   5. Insulation accessories.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
   1. Layout and thickness of insulation.
   2. Base flashings and membrane termination details.
   3. Flashing details at penetrations.
   4. Tapered insulation layout, thickness, and slopes.
   5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
   6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:
   1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
      a. Submit evidence of compliance with performance requirements.
   2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:
   1. Concrete internal relative humidity test reports.
   2. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, substrate board, and other components of roofing system.
   2. Warranty Period: 30 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings to remain watertight.
   1. Accelerated Weathering: Roof to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
   2. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
   1. Fire/Windstorm Classification: Class 1A-90.
   2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 SH.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING SYSTEM

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, TPO sheet.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; JM TPO or a comparable product by one of the following:
      a. Firestone Building Products.
      b. GAF.
   2. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
   3. Thickness: 80 mils (2.0 mm), nominal.
   4. Exposed Face Color: White.

2.3 ACCESSORY ROOFING MATERIALS

A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
   1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 80 mils (2.0 mm) thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARD

A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
   1. Provide type, thickness, and brand as required by membrane manufacturer for specified warranty.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof assemblies.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Johns Manville; a Berkshire Hathaway company; ENRGY 3 or a comparable product by one of the following:
      a. Firestone Building Products.
      b. GAF.
   2. Compressive Strength: 20 psi (138 kPa).

C. Tapered Insulation: Provide factory-tapered insulation boards.
   1. Material: Match roof insulation.
   2. Minimum Thickness: 1/4 inch (6.35 mm).
   3. Slope:
      a. Roof Field: 1/4 inch per foot (1:48) unless otherwise indicated on Drawings.
      b. Saddles and Crickets: 1/2 inch per foot (1:24) unless otherwise indicated on Drawings.

2.6 INSULATION ACCESSORIES AND COVER BOARD

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate.

D. Cover Board: Provide type, thickness, and brand as required by membrane manufacturer for specified warranty.
   1. Glass-Mat Gypsum Cover Board: ASTM C1177/C1177M, water-resistant gypsum board.
   2. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, water-resistant gypsum board.
   3. Fiber-Reinforced Cementitious Cover Board: ASTM C1325, fiber-mat-reinforced cementitious board.
   4. Surface: Primed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

3.4 INSTALLATION OF SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches (610 mm) in adjacent rows.
   1. At steel roof decks, install substrate board at right angle to flutes of deck.
      a. Locate end joints over crests of steel roof deck.
   2. Tightly butt substrate boards together.
   3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   4. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' RoofNav listed roof assembly requirements for specified Windstorm Resistance Classification and FM Global Property Loss Prevention Data Sheet 1-29.
   5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.
   6. Loosely lay substrate board over roof deck.

3.5 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

3.6 INSTALLATION OF ADHERED ROOF MEMBRANE

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

3.7 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Low-slope roof sheet metal fabrications.
2. Copings.

B. Related Requirements:
1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 042000 "Unit Masonry" for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
3. Section 075423 "Thermoplastic-Polyolefin (TPO) Roofing" for materials and installation of sheet metal flashing and trim integral with roofing.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
2. Include identification of material, thickness, weight, and finish for each item and location in Project.
3. Include details for forming, including profiles, shapes, seams, and dimensions.
4. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
5. Include details of termination points and assemblies.
6. Include details of special conditions.

7. Include details of connections to adjoining work.
8. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches (1:5).

B. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Evaluation Reports: For roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
1. For roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 (Z275) coating designation or aluminum-zinc alloy-coated steel sheet in accordance with ASTM A792/A792M, Class AZ50 (Class AZM150) coating

designation, Grade 40 (Grade 275); prepainted by coil-coating process to comply with ASTM A755/A755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:
    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Color: Match RAL 9011 Graphite Black.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil (0.013 mm).

2.3 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) or Aluminum-Zinc Alloy-Coated Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Solder:
1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.4 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:
1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

F. Do not use graphite pencils to mark metal surfaces.

2.5 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet (3.6 m), concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
a. ATAS International, Inc.
b. Berridge Manufacturing Company.
c. Metal-Era, Inc.
d. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.
2. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal 0.028-inch (0.71-mm) thickness.
a. Surface: Smooth, flat finish.
b. Finish: Two-coat fluoropolymer.
3. Corners: Factory mitered and continuously welded.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long sections. Furnish with 6-inch- (150-mm-) wide, joint cover plates. Shop fabricate interior and exterior corners.
   1. Joint Style: Butted with expansion space and 6-inch- (150-mm-) wide, concealed backup plate.
   2. Fabricate from one of the following materials:
      a. Galvanized Steel: 0.028 inch (0.71 mm) thick.
      b. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch (0.71 mm) thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
   1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
   2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of joint.
   3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
   4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
   5. Install continuous cleats with fasteners spaced not more than 12 inches (300 mm) o.c.
   6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
   7. Do not field cut sheet metal flashing and trim by torch.
   8. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by

painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
   1. Space movement joints at maximum of 10 feet (3 m) with no joints within 24 inches (600 mm) of corner or intersection.
   2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
   3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

3.3 INSTALLATION OF COPINGS

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
   1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
   2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

3.5 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines indicated on Drawings and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.7 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Joints in or between fire-resistance-rated construction, and wall/floor intersections.

1.2 ACTION SUBMITTALS

A. Product Data: Joint firestopping.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Listed System Designs: For each joint firestopping system, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approvals according to FM Approvals 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint firestop systems for each type of joint opening indicated from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:
   1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
      a. Joint firestop systems installed with products bearing the classification marking of a qualified product certification agency in accordance with Listed System Designs published by a qualified testing agency.
         1) UL in its online directory "Product iQ."
         2) Intertek Group in its "Directory of Building Products."

2.3 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems must accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

   1. Joint firestopping systems that are compatible with one another, with the substrates forming openings, and with penetrating items, if any.
   2. Provide products that, upon curing, do not re-emulsify, dissolve, leach, breakdown, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture.
   3. Provide firestop products that do not contain ethylene glycol.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hilti, Inc.
      b. Owens Corning, Thermafiber.
      c. ROCKWOOL.

d. Specified Technologies, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

2.4 ACCESSORIES

A. Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

3.4 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections in accordance with ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

A. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nonstaining silicone joint sealants.
   2. Urethane joint sealants.
   3. Mildew-resistant joint sealants.
   4. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Joint sealants.
   2. Joint-sealant backing materials.

B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
   1. Joint-sealant location and designation.
   2. Manufacturer and product name.
   3. Type of substrate material.
   4. Proposed test.
   5. Number of samples required.

B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Manufacturers' special warranties.

B. Installer's special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
   3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
   4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
   5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. GE Construction Sealants; Momentive Performance Materials Inc.
      b. Pecora Corporation.
      c. Sika Corporation - Building Components.
      d. The Dow Chemical Company.
      e. Tremco Incorporated.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bostik; Arkema.

b. Master Builders Solutions.
c. Pecora Corporation.
d. Sherwin-Williams Company (The).
e. Sika Corporation - Building Components.
f. Tremco Incorporated.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Master Builders Solutions.
b. Pecora Corporation.
c. Sherwin-Williams Company (The).

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Sika Corporation - Building Components.
d. The Dow Chemical Company.
e. Tremco Incorporated.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Pecora Corporation.
b. Sherwin-Williams Company (The).
c. Tremco Incorporated.

2.7 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin) or type as approved in writing by joint-sealant manufacturer for joint application

indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    a. Concrete.
    b. Masonry.
3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
   1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
      a. Extent of Testing: Test completed and cured sealant joints as follows:
         1) Perform 10 tests for the first 1000 ft. (300 m) of joint length for each kind of sealant and joint substrate.
         2) Perform one test for each 1000 ft. (300 m) of joint length thereafter or one test per each floor per elevation.
      b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
         1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
      c. Inspect tested joints and report on the following:
         1) Whether sealants filled joint cavities and are free of voids.
         2) Whether sealant dimensions and configurations comply with specified requirements.
         3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
      d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
      e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
   2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

C. Prepare test and inspection reports.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints between metal panels.
      d. Joints between different materials listed above.
      e. Perimeter joints between materials listed above and frames of doors.
   2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.

B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
   1. Joint Locations:
      a. Isolation joints in cast-in-place concrete slabs.
   2. Joint Sealant: Urethane, S, P, 25, T, NT.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Vertical joints on exposed surfaces of unit masonry walls.
   2. Joint Sealant: Urethane, S, NS, 25, NT.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
   1. Joint Locations:
      a. Control joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints between interior wall surfaces and frames of interior doors.
   2. Joint Sealant: Acrylic latex.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Joint Sealant: Silicone, mildew resistant, S, NS, 25, NT.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Exterior standard steel doors and frames.

B. Related Requirements:
   1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, and finishes.

B. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   7. Details of anchorages, joints, field splices, and connections.
   8. Details of accessories.

C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.
   1. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
   2. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality control reports.

1.6 QUALITY ASSURANCE

A. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
   1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on ASTM C1363. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.
   1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM C1363 and meet or exceed the following requirements:
      a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.395, R-Value 2.53, including insulated door, thermal-break frame and threshold.

2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:
   a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

2.2 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
1. Doors:
   a. Thickness: 1-3/4 inches (44.5 mm).
   b. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
   c. Edge Construction: Model 1, Full Flush.
   d. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
   e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
   f. Bottom Edges: Close bottom edges of doors with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
   g. Core: Foamed in place polyurethane and steel reinforced core with no stiffener face welds.
2. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A60 (ZF180) coating.
   b. Construction: Full profile welded.
   c. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. provide thermally broken frame profiles available for use in masonry construction. Fabricate with 1/16” positive thermal break and integral weatherstripping.
3. Exposed Finish: Factory.

2.3 FRAME ANCHORS

A. Jamb Anchors:
1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.4 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

D. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

E. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.5 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
   1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.6 STEEL FINISHES

A. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
      a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
      b. Install frames with removable stops located on secure side of opening.
   2. Floor Anchors: Secure with postinstalled expansion anchors.
      a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   3. Solidly pack mineral-fiber insulation inside frames.
   4. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
      a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
      b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
      c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
      d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
   1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Owner will engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:
   1. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80.

3.4 REPAIR

A. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details material descriptions, dimensions of individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Babcock-Davis.
      b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
      c. Karp Associates, Inc.
      d. Milcor; Hart & Cooley, Inc.
      e. Nystrom, Inc.
   2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
   3. Optional Features: Masonry anchors for frames in masonry walls.
   4. Locations: Wall and ceiling.
   5. Door Size: As indicated on Drawings.
   6. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed.
   7. Frame Material: Same material, thickness, and finish as door.
   8. Latch and Lock: Latch bolt, key operated.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: Same material as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

D. Latch and Lock Hardware:
   1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
   2. Keys: Furnish two keys per lock and key all locks alike.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
   1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment. Confirm compatibility with specified topcoats in Section 099123 “Interior Painting.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.
   2. Electrified door hardware.

B. Related Requirements:
   1. Section 081113 "Hollow Metal Doors and Frames."
   2. Section 083113 "Access Doors and Frames" for access door hardware.

1.2 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For electrified door hardware.
   1. Include diagrams for power, signal, and control wiring.
   2. Include details of interface of electrified door hardware and building safety and security systems.

C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
   1. Tag Samples with full product description to coordinate Samples with door hardware schedule.

D. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

E. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of electrified door hardware.

C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

B. Schedules: Final door hardware and keying schedule.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
   1. Scheduling Responsibility: Preparation of door hardware and keying schedule.
   2. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Faulty operation of doors and door hardware.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period:
   a. Warranty Period for Manual Closers: 10 years.
   b. Warranty Period for Exit Devices: 3 years.
   c. Warranty Period for Locks: 7 years.
   d. All other hardware one year.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of door hardware from single manufacturer.
   1. 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.

B. Product: Subject to compliance with requirements, provide the product named for each door hardware item indicated in Door Hardware Sets.

C. Basis-of-Design Product: Product named for each door hardware item indicated in Door Hardware Sets establishes the basis of design. Provide either the named product or a comparable product by one of the manufacturers specified for each type of hardware item.

D. Manufacturers Used in the specification:

Products	Manufacture Specified	Acceptable Equals
Continuous Hinges	Ives	Roton, Select
Locksets	Schlage L9000	Sargent, Best
Card Readers/Keypads	Electronics DL2700	No Substitutions
Exit Devices	Von Duprin 99 Series	Precision, Detex
Closers	LCN 4040XP	Sargent 281 CR 8200
Overhead Stops	Glynn Johnson	Rixson, ABH
Push/Pulls, Stops	Ives	Hager, Rockwood
Flushbolts	Ives	Hager, Rockwood
Thresholds/Seals	Zero	NGP, Pemko
Key Cabinet	Lund	Telkee
Cylinders	Yale	No Substitutions

2.2 PERFORMANCE REQUIREMENTS

A. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

2.3 HINGES

A. General: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Hinge Base Metal: Unless otherwise indicated, provide the following:
   1. Exterior Hinges: Stainless steel, with stainless-steel pin.
   2. Interior Hinges: Steel, with steel pin.
   3. Hinges for Fire-Rated Assemblies: Steel, with steel pin.

C. Non-removable Pins: Provide set screw in hinge barrel that prevents removal of pin while door is closed; for out-swinging exterior doors.

D. Screws: Phillips flat-head screws; screw heads finished to match surface of hinges.

E. Metal Doors and Frames: Machine screws (drilled and tapped holes).

2.4 MECHANICAL LOCKS AND LATCHES

A. Mortise Locks:
   1. Locks shall be ANSI A156.13, Grade 1 mortise locksets, manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
   2. Locks to have a standard 2-3/4” backset with a full 3/4" throw stainless steel mechanical anti-friction latch bolt. Deadbolt shall be a full 1” throw, constructed of stainless steel.
   3. Lever trim shall be cast or forged in the design specified, with 2-1/8” diameter roses. Levers to be thru-bolted to assure proper alignment. Trim shall be applied by threaded bushing “no exposed screws”.

B. Cylindrical Locks:
   1. Locks shall be ANSI A156.2, Series 4000 Grade 1 UL Listed for 3-hour doors. Manufactured from heavy gauge cold rolled steel mechanisms that are corrosion treated for normal conditions.
   2. Locks to have standard 2-3/4” backset with a full 1/2" reversible dead latch. Thru-bolted mounting post for positive interlock to the door with concealed mounting screws.
   3. Lever trim shall be pressure cast zinc to match finishes. The design specified, with 3-7/16” diameter roses. Trim shall be applied by “no exposed screws”.

2.5 BOLTS

A. Shall have forged bronze faceplate with extruded brass lever wrought brass guide and strike. Flush bolts for hollow metal doors shall be extension rod type door up to 7’6” in height shall have 12” steel or brass rods, manual flush bolts for doors over 7’6” in height shall be increased by 6” for each additional 6” of door height. Wood doors shall have corner-wrap type. Provide dust proof strikes for all bottom bolts.

2.6 EXIT DEVICES

A. Panic Exit Devices: Listed and labeled for panic protection, based on testing according to UL 305.

B. Fire Exit Devices: Complying with NFPA 80 that are listed and labeled for fire and panic protection, based on testing according to UL 305 and NFPA 252.

C. All lever design shall match mortise or cylindrical lock lever designs.

D. All devices to incorporate a security dead-latching feature. Provide roller strikes for all rim and surface mounted vertical rod devices, ASA strikes for mortise devices, and manufacturer's standard strikes for concealed vertical rod devices.

E. Removable Mullions: BHMA A156.3.
   1. Fire-Exit Removable Mullions: Complying with NFPA 80 that are listed and labeled for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

F. Carry-Open Bars: Provide carry-open bars for inactive leaves of pairs of doors, unless automatic or self-latching bolts are used.

2.7 CLOSERS

A. Surface-Mounted Closers:
   1. Spring power shall be continuously adjustable over the full range of closer sizes, and allow for reduced opening force for the physically handicapped. Hydraulic regulation shall be by tamper-proof, non-critical valves. Closers shall have separate adjustment for latch speed, general speed, and back check.

B. All closers will not be seen on the public side or hallway side of the door. The appropriate drop plate or mounting plates will be provided as conditions and special templating dictates.

2.8 PROTECTIVE TRIM UNITS

A. Protective Trim Units: Sized 2" inches less than door width on push side and 1" inch less than door width on pull side, by height scheduled or indicated. Fasten with exposed machine or self-tapping screws.

2.9 STOPS AND HOLDERS

A. Stops and Holders: Provide floor stops for doors, unless wall or other type stops are scheduled or indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.

B. Silencers for Door Frames: Neoprene or rubber; fabricated for drilled-in application to frame.

2.10 DOOR GASKETING AND THRESHOLDS

A. Door Gasketing: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide non-corrosive fasteners for exterior applications and elsewhere as indicated.

2.11 CYLINDERS, KEYING, AND STRIKES

A. Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

B. Keying System: Factory-registered keying system; grand master key system.

2.12 FABRICATION

A. Base Metals: Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18 for finishes. Do not furnish manufacturer's standard materials if different from specified standard.

B. Fasteners: Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated. Provide steel machine or wood screws or steel through bolts for fire-rated applications.

C. Spacers or Sex Bolts: For through bolting of hollow metal doors.

D. Fasteners for Wood Doors: Comply with requirements of DHI WDHS.2, "Recommended Fasteners for Wood Doors."

E. Finishes: Comply with BHMA A156.18. As shown in hardware sets.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
   2. Custom Steel Doors and Frames: HMMA 831.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
   1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
   1. Furnish permanent cores to Owner for installation.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
   1. Do not notch perimeter gasketing to install other surface-applied hardware.

H. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
   2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.8 DOOR HARDWARE SCHEDULE

HARDWARE GROUP NO. 01

FOR USE ON DOOR #(S):
101 102

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	ELECTRONIC LOCK	DL2700 IC	626	ALA
1	EA	I C CORE	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER

OPERATION: DOOR CLOSED AND SECURED. VALID CODE ALLOWS ENTRY. FREE EGRESS AT ALL TIMES.

HARDWARE GROUP NO. 02

FOR USE ON DOOR #(S):
103

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	STOREROOM LOCK	L9080L 17A	626	SCH
1	EA	HOUSING AS REQUIRED	CYL HOUSING	626	YAL
1	EA	I C CORE	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER

HARDWARE GROUP NO. 03

FOR USE ON DOOR #(S):
104A

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	FIRE EXIT HARDWARE	99-L-NL-F-17	626	VON
1	EA	HOUSING AS REQUIRED	CYL HOUSING	626	YAL
1	EA	I C CORE	AS REQUIRED	626	YAL
1	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER

HARDWARE GROUP NO. 04

FOR USE ON DOOR #(S):
104B

PROVIDE EACH OPENING WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY	628	IVE
1	EA	AUTO FLUSH BOLT	F31P/FB41P AS REQ'D	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	FIRE EXIT HARDWARE	9975-L-NL-F-17	626	VON
1	EA	HOUSING AS REQUIRED	CYL HOUSING	626	YAL
1	EA	I C CORE	AS REQUIRED	626	YAL
1	EA	COORDINATOR	COR X FL X MBF AS REQUIRED	628	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH SRI	689	LCN
1	EA	RAIN DRIP	142AA	AA	ZER
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA (MOUNT TO Z ASTRAGAL)	BK	ZER
1	EA	ASTRAGAL	Z TYPE ASTRAGAL BY HM DR SUPPLIER		B/O
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-223	A	ZER

END OF SECTION 087100

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Suspension systems for interior ceilings and soffits.
   2. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:
   1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For embossed, high-strength steel studs and tracks and, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, the Steel Stud Manufacturers Association, or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Notify manufacturer of damaged materials received prior to installation.

B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.

B. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. (239 Pa) minimum as required by the IBC.

2.2 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

C. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.367 mm) and minimum 1/2-inch- (13-mm-) wide flanges.

D. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch (1.367-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
2. Steel Studs and Tracks: ASTM C645.
   a. Minimum Base-Steel Thickness: 0.0179 inch (0.455 mm).
   b. Depth: As indicated on Drawings.
3. Embossed, High-Strength Steel Studs and Tracks: ASTM C645.
   a. Minimum Base-Steel Thickness: 0.0147 inch (0.373 mm).
   b. Depth: As indicated on Drawings.

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Do not attach hangers to steel roof deck.
5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.

B. Related Requirements:
   1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Gypsum ceiling board.
   2. Interior trim.
   3. Joint treatment materials.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Ceiling Board: ASTM C1396/C1396M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Certainteed; SAINT-GOBAIN.
      b. Continental Building Products Inc.
      c. Gold Bond Building Products, LLC provided by National Gypsum Company.
   2. Thickness: 1/2 inch (12.7 mm).
   3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
      a. Use setting-type compound for installing paper-faced metal trim accessories.
   3. Fill Coat: For second coat, use drying-type, all-purpose compound.
   4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
   1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

3.5 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
   1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes surface preparation, priming, and finish painting for surfaces indicated.

B. Related Requirements:
   1. Section 099600 "High-Performance Coatings" for coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include preparation requirements and application instructions.
   2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

D. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.4 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND TYPES

A. General:
1. Use only one manufacturer's products within a paint system. Do not intermix or thin one product line with another.
2. Provide pure, nonfading color pigments of the type and quality to suit substrates and service indicated.

B. Materials and Manufacturers:
1. To establish quality and type of paint required, specific paint materials are listed in Paint Schedule in Part 3 of this Section. Equal paint materials of the other listed acceptable manufacturers may be substituted for materials listed but colors must match colors listed.
2. Acceptable Manufacturers: Manufacturers capable of providing acceptable special coating materials and are capable of matching selected colors and finish include the following:
   a. Benjamin Moore & Co.
   b. Sherwin-Williams (S-W).
   c. ICI Paints, Inc.
   d. PPG Paints
   e. Pratt and Lambert

C. Paint Coordination:
1. Provide finish coats compatible with prime coats used. Review other Sections of these Specifications for compatibility of total coatings system.
2. Upon request from other trades, furnish information on characteristics of proposed finish materials to ensure compatible prime coats.
3. Provide barrier coats over incompatible primers or remove and re-prime as required to provide a proper paint system.
4. Notify Architect in writing of any anticipated problems using specified coating systems with surfaces shop-primed by others.

D. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
3. Products shall be of same manufacturer for each coat in a coating system.

E. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.
4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.

7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

2.2 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Masonry (Clay and CMUs): 12 percent.
   2. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
   1. Contractor shall touch up and restore painted surfaces damaged by testing.
   2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
   1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
   2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
   3. Allow empty paint cans to dry before disposal.
   4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Gypsum Board Ceilings - Flat, Low-Odor/Low VOC:
   1. Primer: 1 coat S-W ProMar 200 Zero VOC Latex Primer
   2. Finish: 2-3 coats S-W ProMar 200 Zero VOC Latex Flat

B. Concrete Masonry Units, Interior - Low-Odor/Low VOC:
   1. Primer: 1 coat S-W Pro Industrial Heavy Duty Block Filler.
   2. Finish: 2 coats S-W Pro Industrial, Pre-Catalyzed, Water-Based Epoxy, Eg-Shel.

C. Steel Access Doors and Frames:
   1. Primer: Factory primed; confirm primer compatibility with topcoat
   2. Finish: 2 coats S-W Pro Industrial, Pre-Catalyzed, Water-Based Epoxy, Eg-Shel

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of high-performance coating systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.4 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product listed in the Part 3 Coating Schedule or comparable product by one of the following:
   1. Steel Coatings:
      a. International Protective Coatings.
      b. PPG Paints; PPG Industries, Inc.
      c. Sherwin-Williams Company (The).
      d. Tnemec Company, Inc.
   2. Anti-Graffiti Coatings:
      a. Rainguard Pro.
      b. Sika Limited.
      c. Sherwin Williams
      d. Prosoco

2.2 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
   3. Products shall be of same manufacturer for each coat in a coating system.

2.3 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:
   1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

G. Aluminum Substrates: Remove loose surface oxidation.

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
   1. Use applicators and techniques suited for coating and substrate indicated.
   2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
   1. Contractor shall touch up and restore coated surfaces damaged by testing.
   2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 HIGH-PERFORMANCE COATING SCHEDULE

A. Masonry Substrates, Vertical Surfaces, Anti-Graffiti Coating:
   1. Surface Preparation: Surfaces shall be clean and dry with no oils, dirt, debris, or minerals such as efflorescence, lime and calcium
   2. Finish: 2 coats VandlGuard Non-Sacrificial Coating

B. Galvanized-Structural Steel Substrates:
   1. Pigmented Polyurethane over Epoxy Primer System:
      a. Surface Preparation: In accordance with manufacturer's written instructions.
      b. Shop-Applied Prime Coat: 1 coat Sherwin Williams Macropoxy 646.
      c. Finish: 2 coats Sherwin Williams Acrolon 218HS.

C. Exposed Construction at Ceilings including Steel Deck and Structural Steel:
   1. Surface Preparation: All surfaces must be smooth and clean.
   2. Finish: 2 coats S-W ProIndustrial Acrylic Dryfall

END OF SECTION 099600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Public-use washroom accessories.
2. Hand dryers
3. Underlavatory guards.
4. Portable Emergency Eye Wash

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Samples: For each exposed product and for each finish specified, full size.
1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, visible silver spoilage defects.
   2. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Provide fasteners to comply with the following requirements:
   1. Grab Bars: Installed units are able to resist 250 lbf (1112 N) concentrated load applied in any direction and at any point.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.

B. Toilet Tissue (Roll) Dispenser:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Tork 565828 3-Roll Bath Tissue Dispenser or a comparable product by one of the following:
      a. AJW Architectural Products.
      b. ASI-American Specialties, Inc.
      c. Bradley Corporation.
      d. Brey-Krause Manufacturing Co.
      e. Tubular Specialties Manufacturing, Inc.
   2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
   3. Mounting: Surface mounted.
   4. Operation: Noncontrol delivery with theft-resistant spindle.
   5. Capacity: Designed for 5-inch- (127-mm-) diameter tissue rolls.
   6. Material and Finish: ABS plastic, black.

C. Automatic Soap Dispenser:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide GOJO TFX Dispenser Model 2740-12 or comparable product by one of the following:
      a. AJW Architectural Products.
      b. ASI-American Specialties, Inc.
      c. Bradley Corporation.

2. Description: Automatic dispenser with sensor to detect presence of hands; battery powered; designed for dispensing soap in lather form.
3. Mounting: Wall mounted.
4. Capacity: 1200 ml.
5. Materials: White plastic.
6. Refill Indicator: Sight window.

D. Grab Bar:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-6806 or a comparable product by one of the following:
   a. AJW Architectural Products.
   b. ASI-American Specialties, Inc.
   c. Bradley Corporation.
   d. Brey-Krause Manufacturing Co.
   e. Tubular Specialties Manufacturing, Inc.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
   a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches (38 mm).
5. Configuration and Length: As indicated on Drawings.

E. Sanitary-Napkin and Tampon Vendor:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-47069C or a comparable product by one of the following:
   a. AJW Architectural Products.
   b. ASI-American Specialties, Inc.
   c. Bradley Corporation.
   d. Tubular Specialties Manufacturing, Inc.
2. Mounting: Surface mounted.
3. Capacity: 30 tampons, 20 napkins.
4. Operation: No coin (free).
5. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type with separate lock and key for coin box.

F. Sanitary-Napkin Disposal Unit:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-270 or a comparable product by one of the following:
   a. AJW Architectural Products.
   b. ASI-American Specialties, Inc.
   c. Bradley Corporation.
   d. Brey-Krause Manufacturing Co.
   e. Tubular Specialties Manufacturing, Inc.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

G. Seat-Cover Dispenser:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-4221 or a comparable product by one of the following:
   a. AJW Architectural Products.

b. ASI-American Specialties, Inc.
c. Bradley Corporation.
d. Brey-Krause Manufacturing Co.
e. Tubular Specialties Manufacturing, Inc.

2. Mounting: Surface mounted.
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
5. Lockset: Tumbler type.

H. Mirror Unit:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-290 Welded-Frame Mirror or a comparable product by one of the following:
   a. AJW Architectural Products.
   b. ASI-American Specialties, Inc.
   c. Bradley Corporation.
   d. Brey-Krause Manufacturing Co.
   e. Tubular Specialties Manufacturing, Inc.
2. Frame: Stainless steel angle, 0.05 inch (1.3 mm) thick.
   a. Corners: Welded and ground smooth.
3. Size: As indicated on Drawings.
4. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

I. Hook:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-6827 or a comparable product by one of the following:
   a. AJW Architectural Products.
   b. ASI-American Specialties, Inc.
   c. Bradley Corporation.
   d. Brey-Krause Manufacturing Co.
   e. Tubular Specialties Manufacturing, Inc.
2. Description: Combination hat and coat hook.
3. Mounting: Concealed.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 HAND DRYERS

A. Source Limitations: Obtain hand dryers from single source from single manufacturer.

B. High-Speed Air Dryer:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Excel Dryer Inc., XLERATOR XL-BW or a comparable product by one of the following:
   a. AJW Architectural Products.
   b. ASI-American Specialties, Inc.
   c. Bobrick Washroom Equipment, Inc.
   d. Bradley Corporation.
   e. Mitsubishi Electric US, Inc.
   f. World Dryer Corporation.
2. Description: High-speed, warm-air hand dryer for rapid hand drying.
3. Mounting: Surface mounted.

4. Operation: Infrared-sensor activated with timed power cut-off switch.
   a. Average Dry Time: 8 seconds.
   b. Automatic Shut Off: At 60 seconds.
5. Maximum Sound Level: 75 dB.
6. Cover Material and Finish: Steel, with white finish.
7. Electrical Requirements: 115 V, 12 A, 1450 W, minimum.

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Buckaroos, Inc.
      b. Plumberex Specialty Products, Inc.
      c. Truebro; IPS Corporation.
   2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
   3. Material and Finish: Antimicrobial, molded plastic, white.

2.5 PORTABLE EMERGENCY EYE WASH

A. Self-Contained Eyewash Unit:
   1. Equal to Bradly Corporation Model S19-921 On-Site Gravity-Fed Eyewash.
   2. Flushes eyes for 15 minutes at a minimum of 0.4 gallons/minute by using only 7 gallons of water.
   3. Tank: 12-inches x 22-inches x 9-inches, made of translucent white high-density polyethylene; 7-gallon capacity.
   4. Pedestal: 13-1/2 inches x 22-inches x 18-1/2 inches, made of opaque yellow polypropylene, with black polypropylene pull-down arm.
   5. Wall Bracket: Stainless steel
   6. Exceeds American National Standard Z358.1 Specifications.
   7. Includes universal identification sign and inspection tag

2.6 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- (0.8-mm-) minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- (0.9-mm-) minimum nominal thickness.

C. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

D. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

E. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
   1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION 102800

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
   1. Source Limitations: Obtain fire extinguishers and accessories, from single source from single manufacturer.
   2. Valves: Nickel-plated, polished-brass body.
   3. Handles and Levers: Stainless steel.
   4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
   1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
   1. Mounting Height: Top of fire extinguisher to be at 42 inches (1067 mm) above finished floor.

END OF SECTION 104416

SECTION 23 00 00 – MECHANICAL AND PLUMBING FOR COMFORT STATION

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Heating, ventilating, and air conditioning (HVAC) equipment.
2. Plumbing equipment.
3. Definitions for the manner and method by which controls function.
4. Ductwork and piping insulation.

1.02 REFERENCES

A. Wisconsin Administrative Code (2018):

1. Chapter 363 – Energy Conservation.
2. Chapter 364 – Heating, Ventilating, and Air Conditioning.
3. Chapter 382 – Design, Construction, Installation, Supervision, and Inspection of Plumbing.

B. Madison, Wisconsin – Code of Ordinances / Chapter 18 – Plumbing Code.

1.03 SUBMITTALS

A. Submit to the Engineer for review and approval complete construction drawings, shop details, installation drawings, catalog data, manufacturer's literature, etc. Complete submittals required include, but are not limited to, waste and vent piping, water piping, water closets, lavatories, tankless water heaters, hose bibbs, wall hydrants, floor drains, electric wall heaters, exhaust ventilators, miniature split systems, toilet accessories and other pertinent items.

1.04 DEFINITIONS

A. Control Sequences: Manner and method by which automatic temperature controls function. Requirements for each type of operation are described in this section.

B. Normal Mode: Mode or position-controlled device assumes without power.

C. Automatic Mode: Mode or position-controlled device assumed when under control of automatic system of controls.

D. Manual Mode: M<de or position-controlled device assumes when under manual control. Unless otherwise specified, manual mode implied and affects only device for which manual mode or position identified.

1.05 QUALITY ASSURANCE

A. Manufacturer's Quality System:

1. Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
1. The control must be UL tested and certified.

B. Interpret specific reference in these specifications to any article, device, product, material, fixture, form or type of construction, etc., by name, make or catalog number as establishing a standard of quality. Do not construe specific references as limiting competition. Use any article, device, product or material, fixtures, form, or type of construction, which in the judgment of the architect is equal to that named in the special provisions or shown on the plans.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide all plumbing fixtures, piping and accessories as outlined in this section meeting ASME A112.119.3.

B. Provide all heating and ventilation equipment, wiring, and accessories as outlined within this section.

C. Provide all products and workmanship of the highest commercial or industrial quality available. Lesser quality products, such as “economy grade”, will not be acceptable. The engineer will reject any product or work that is inferior in his/her judgment.

2.02 WASTE AND VENT PIPING

A. Waste and vent piping shall be ABS or PVC plastic.

2.03 WATER PIPING

A. Copper tubing Type L, hard drawn. Provide a gate or ball valve at the inlet end of the water line. Size water lines to provide proper flushing action based on a nominal water pressure of 40 psi.

B. Provide a main shut-off valve and water meter at the water service entrance.

C. Provide a water hammer arrestor, to be installed on water line.

D. Buried water piping to be type K soft copper.

2.04 WATER CLOSETS (WC-1)

A. Ceramic, ADA compliant, wall hung, elongated bowl, with siphon or blowout jet action. Provide back spud for concealed 1.6 gpf flush valve connection. Kohler Kingston K-4323, or approved equal.

2.05 LAVATORIES (L-1)

A. Ceramic, wall mount, ADA compliant, with backsplash and carrier. Kohler Chesapeake K-1728, or approved equal.

B. Lavatory valves to be pneumatically operated pushbutton valve. Valve to be non-hold open type with a vandal resistant pushbutton requiring less than 5 lbs pressure to activate.

2.06 TANKLESS WATER HEATER (TWH-1-2)

A. Electric, 3500 Watts, 120 V. single phase, with high temperature limit switch. Mounting location must be located within 2 feet of fixture. Eemax AccuMix II AM004120T, or approved equal.

2.07 HOSE BIBB (HB-1)

A. Hose bibb to be provided in janitor's closet/storage room.

2.08 WALL HYDRANT (WH-1)

A. Wall hydrant shall be a box type Woodford Model B67, automatic draining with ASSE 1052 approved NIDEL Model 50HA high flow double check backflow preventer. 3/4" male inlet and outlet. Hardened stainless steel operating stem and one-piece valve plunger to control both flow and drain functions. Exterior finish to be chrome plated. Loose tee key to be furnished with each hydrant. Wall thickness to be 16 inches.

2.09 FLOOR DRAINS (FD-1)

A. PVC or ABS body with height adjustment, 4" outlet and polished nickel-bronze grate. Zurn Model EZ1, or approved equal.

2.10 ELECTRIC WALL HEATER (EWH-1-6)

A. Janitor's closet and toilet space: Fan forced 13 MBH, 208 V., single phase with surface-mount trim and integral thermostat. QMark CWH3408F, or approved equal.

B. Electrical room: Three fan forced electric wall heaters, 13 MBH each, 208 V., single phase with surface-mount trim and integral thermostat. QMark CWH3408F, or approved equal.

2.11 EXHAUST VENTILATOR (EF-1-2)

A. Toilet space: In-line centrifugal, 75 cfm, 115 V., single phase with speed controller, 6" dia. duct connections. Interlock with light switch and reverse-acting thermostat. Fantech Model FG 6, or approved equal. Terminate duct at 8"x8" wall cap.

2.12 AIR INTAKE OPENING (L-1-2, SG-1)

A. Toilet space: 6” dia. PVC with motorized damper interlocked with fan, and exterior louvered PVC intake with insect screen. Fantech Model COM-6P, or approved equal. Interior grille: Fantech Model DG-6, or approved equal.

2.13 MECHANICAL COOLING (AC-1/CU-1)

A. Electrical room: 30 MBH mini split system with outdoor condensing unit. 208 V., single phase for the condensing unit. 15.5 SEER. 775 CFM. Refrigerant R-410A. Mitsubishi Model PKA-A30KA4, or approved equal.

2.14 CONCRETE SPLASH PAD

A. Concrete splash pads to be installed on exterior of building to accommodate roof drain overflow lines. 22GPM for the electrical room. 8 GPM for the toilet space and janitor’s closet.

2.15 INSULATION ACCESSORIES

A. Ductwork Insulation Accessories: Provide staples, wires, bands, wire netting, stud pins, and metal cover tape, anchors, corner angles, and similar accessories as recommended by insulation manufacturer for application indicated.

2.16 VAPOR BARRIER AND JACKETING MATERIALS

A. JK1, Kraft Paper Faced Vapor Barrier Material: FS HH B 100B, Type I, all service type aluminum foil and fiberglass yarn reinforced kraft paper. Manville Type AP, or equal.
   a. Maximum water vapor permeability, ASTM E96/E96M, 0.02 perms.
   b. Minimum tensile strength, ASTM D828, 40 lbs/in. width.
   c. Minimum Mullen burst pressure, ASTM D774/D774M, 70 psi.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Install all equipment in strict compliance with applicable laws and the latest rules and regulations of all municipal and other public agencies having jurisdiction over this work.

C. Complete the utility service connections to provide a fully functional restroom facility.

D. Install water hammer arrester on water line.

E. Install heating and ventilating equipment, wiring and accessories to comply with manufacturer’s written instructions.

F. Install electrical components to comply with manufacturer’s written instructions.

3.02 CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces.

3.03 WARRANTY

A. For all items of work to be performed under this article, guarantee each item against defects in material and workmanship for a period equal to the standard warranty period of the manufacturer or the industry, whichever is longer. Commencement of the warranty period begins after final acceptance of the work. In the event of a legitimate claim, replace or repair the defective item, in whole or in part, as necessary, to restore the item to its original intended state.

3.04 PIPING

A. Exposed Piping: Locate insulation and cover seams in least visible locations.

B. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, up to 3’ from the pump seal water connection.
   a. Provide standard jackets with or without vapor barrier, factory applied or field applied.
   b. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
   c. Finish with glass cloth and vapor barrier adhesive.
   d. PVC fitting covers may be used.
   e. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
   f. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
   g. Provide formed insulation segments capable of being removed for service and reinstalled without damage to the segments or vapor barrier sealing tapes for valves, pipe flanges, unions, and valve flanges.

C. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07840 for penetrations of assemblies with fire resistance rating greater than one hour.

D. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

E. Insulate piping and equipment less than 8 foot above finished floors in locations accessible to personnel contact so that temperatures of exposed surfaces do not exceed 180 degrees F.

3.05 AIR CONDITIONING UNITS

A. Units Served:

a. AC-1/CU-1

B. General

a. Two way control valve shall fail open upon loss of power.

C. Normal Mode: Off

a. Fan: Off
b. Control Valve: Closed

D. Automatic Mode: On.

a. Units shall be controlled by space thermostat set at 65°F (field adjustable). On call for heat, thermostat shall engage with electric wall heaters within space. When space heating requirements are satisfied, thermostat shall disengage with electric wall heaters within space.

END OF SECTION

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.
3. Firestopping of electrical installation

1.3 SUBMITTALS

A. General

1. Make all submittals in accordance with Division 1, herein, and individual sections in Divisions 26.
2. Identify all submittals with corresponding specification section number and name. Each submittal shall typically be limited to one specification section, except in cases where similar equipment or services are commonly furnished in one package, e.g., short-circuit, coordination, and arc-flash studies; or low-voltage distribution equipment such as switchboards, panelboards, disconnects, and motor controls; or interior lighting, exterior lighting, emergency and exit lighting.
3. Clearly identify all submittals with project name and location, and manufacturer's name. Contractor shall thoroughly review and approve all submittals for accuracy and completeness prior to submitting to Architect. Mark each submittal with company name, reviewer's initials and date of review. Submittals not so approved and marked will be rejected, and resubmittal will be required.
4. Provide a complete list of all requirements for which submitted products are NOT in conformance with Specifications and Drawings, and associated reasons for non-conformance. Unless noted otherwise on submittal, products are assumed to meet all Specification and Drawing requirements and are expected to be furnished in accordance with those requirements.
5. Clearly mark product data copies to identify pertinent products, models, or part numbers. Circle, highlight, or otherwise clearly identify specific items that are being proposed on the submitted product data or shop drawings. Show performance characteristics and capacities, dimensions and clearances required, and wiring diagrams and controls.

6. Submit indexed and bound sets of shop drawings and/or product data sheets for items listed in individual sections of Divisions 26 prior to ordering material and starting construction.
7. Re-submittals shall be new and complete, void of previous submittal comments and engineer's review stamp, revised to incorporate all comments and additional information as noted or requested on previous submittals, and inclusive of all previous submittal information not requiring revisions.
8. Submit a minimum of one (1) electronic copy and two (2) hard copies of bound and indexed operation and maintenance instruction manuals, parts lists, new and revised, up-to-date shop drawings and product data sheets, void of previous submittal comments and engineer's review stamp, incorporating all previous comments, additional requested information, addendum and bulletin changes, etc., and record drawings for items listed in individual sections of Divisions 26 test reports, as part of close-out documents.
9. Submit documentation of electrical inspection final approval.

1.4 QUALITY ASSURANCE

A. Furnish only new, first-class quality, materials and equipment, delivered, erected, connected and finished in every detail, selected and arranged to fit properly into building spaces. Where no specific kind or quality of material is specified, furnish first-class standard article, approved by Architect.

B. Furnish services of one or more experienced superintendents, to be in charge of installation of work, and all skilled workmen, electricians and laborers required to unload, transfer, erect, connect, adjust, start, operate and test each system.

C. Provide all component parts of each item of equipment or device with manufacturer's nameplate, giving name of manufacturer, description, size, type, serial number, electrical characteristics, etc., to facilitate maintenance or replacement. Nameplate of Subcontractor or distributor is not acceptable.

D. Job conditions, which govern when and how products shall be installed, are generally covered in Division 1 and specifically covered in individual paragraphs of Division 26.

E. Do NOT install any product where it might be exposed to environment that is extremely different to that in which it was intended to be normally used.

F. Perform all work in close cooperation with other trades and utility companies.

G. Comply with latest edition or revision of each standard or code mentioned in these specifications and as follows:

1. American National Standard Institute (ANSI)
2. American Society for Testing Materials (ASTM)
3. National Electrical Manufacturer's Association (NEMA)
4. Underwriters' Laboratories (UL)
5. National Fire Protection Association (NFPA) -
6. State and Local Municipality Building and Electrical Codes and Ordinances.

H. 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.

I. Execute all work in conformity with best standards of practice. Lay out and install work in accordance with drawings, manufacturer's instructions, shop drawings, and field layouts of other trades.

J. Drawings are diagrammatic and indicate the general arrangement and intent of systems and work included in these documents.

K. Furnish all labor, material and equipment to install and successfully test electrical systems and work, complete and in place, as herein specified and as shown on drawings.

L. Program all monitoring and control systems for all equipment with input from Owner.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 for general requirements pertaining to delivery, storage and handling.

B. Protect materials before, during and after installation.

C. In event of damage, immediately make all repairs and replacements necessary at no additional cost.

D. Deliver all materials to job-site in original unopened containers, where applicable, with all labels intact and legible at time of use. Store in strict accordance with manufacturer's recommendations.

E. Examine all equipment and material delivered to jobsite prior to installation to ensure all specification requirements and shop drawing notes and comments have been incorporated by manufacturer. Installation of equipment or material signifies Contractor’s acceptance and approval of equipment or material from manufacturer.

1.6 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. In cases of interferences between various items of equipment and building features, or if simplified construction is made possible by relocation of certain equipment, bring such conditions to attention of Architect. Changes in arrangements may be made only if authorized by Architect.

C. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

E. Substitutions and Changes

1. Comply with Instructions to Bidders.
2. Contractor is responsible to notify all parties concerned of any changes or substitutions he has been authorized to make, and must include in his notice a full description, including drawings if necessary, of any deviation from dimensions shown on plans of any trade.
3. If Contractor provides equipment other than that upon which design is based, it shall be his responsibility to coordinate its installation with work of all other trades and with space available, and pay for any changes caused to other trades as a result of this substitution.
4. If other contractors provide equipment other than that upon which design is based, electrical contractor shall coordinate electrical equipment and connections, including sizes of switches, fuses, breakers, starters, wiring, etc., with requirements of furnished equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material shall be produced by company which has been engaged in manufacture of such types of materials for period of at least five (5) years.

B. Provide electrical products as described under specific paragraphs in this division. Refer to various paragraphs for correct product identification (e.g. “Low-Voltage Electrical Power Conductors and Cables”, Section 260519).

2.2 SPARE MATERIAL

A. Refer to individual sections for spare material requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Drawings constituting part of these documents are diagrammatic and indicate general arrangement of systems and work included in documents.

B. Coordinate necessary preparation required for electrical equipment installation with all trades.

C. Carefully check and coordinate location and level of all lighting fixtures, conduits, junction boxes, etc., located in exposed ceiling areas. If conflicts occur, follow space preference below (in order of first to last):

1. Recessed lighting fixtures.
2. High pressure ductwork.
3. Air terminal units.
4. Low pressure ductwork.
5. Cable tray.
6. Soil, waste, vent, and storm piping.
7. Sprinkler piping.
8. Liquid heat transfer and refrigerant piping.
9. Domestic water piping.
10. Electrical conduit.

D. Locate conduits, junction boxes, etc., to allow access to air terminal units, piping, control valves, etc., for maintenance and repair. Conversely ensure light fixtures, etc. are clear of piping etc. to allow access for maintenance.

E. Verify locations of outlets and types of connections required for equipment installed by others.

F. Relocate any improperly located outlet, and replace any incorrect connection caused by lack of preparation or coordination. Also, repair to the Architect's/Owner's satisfaction any hole, etc., caused by these relocations/replacements.

3.2 ADJUSTMENTS AND CLEANING

A. Cutting and Patching

1. Do all cutting and patching necessary for installation of electrical work with approval, and under supervision of, Architect.
2. Do not impair strength or function of work being cut or patched, i.e., do not weaken structural members and waterproof holes through exterior walls and ground floor. Use rotary type drilling tools and concrete cutting saws to cut concrete and masonry walls. Do not use torches for cutting steel.

B. Wall, Floor and Ceiling Openings

1. Place all sleeves necessary for electrical installation and advise other Contractors of all openings necessary for installation of electrical work.
2. Provide sleeves necessary for installation of fire alarm, telephone, video, data, sound, etc., system cables. If system wiring has not been installed at time of building official's inspection, seal all sleeves. Subsequent penetrations and sealing will be done by System Contractor.
3. Repair and finish all holes placed for conduit if such holes are placed after general construction is completed.
4. For fire-rated stud wall or partitions, provide 24 inch minimum horizontal separation between boxes on opposite sides of same wall or partition unless noted otherwise on Drawings and where an engineered solution such as applying UL listed fire stop material similar to Hilti CP 617 firestop putty pads, around backs of offending boxes is indicated on Drawings.

C. Excavation and Backfill

1. Perform excavation and backfilling necessary to install the electrical system in accordance with Contract Documents and appropriate sections of Divisions 26.

D. Concrete Work

1. Bases for outdoor lighting standards, raised pads for switchboards, distribution panels, switchgear, substations and similar equipment, and pads for transformers, including the setting of mounting bolts, constructed by Division 3 Contractor.
2. Furnish mounting bolts, place conduit; and deliver mounting and placement templates to Division 3 Contractor.

E. Painting

1. Furnish panelboards and cabinets in finished areas with prime coat of paint. Furnish panelboards and cabinets in unfinished areas with standard factory finish.
2. Paint all fire alarm system panels, emergency panels and associated junction boxes, and pull boxes red.

F. Protection

1. Provide final protection of all electrical conduit, wiring, enclosures, equipment and panels, and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of substantial completion.
2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
3. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.
4. Protect all electrical and electronic equipment from falling metal shavings before and during construction.

G. Housekeeping and Clean-up

1. Remove from site all debris and rubbish accumulating as result of electrical installation. Dispose of all debris and rubbish. Leave all electrical equipment rooms broom clean.

2. Clean interiors of all cabinets, pull boxes, and equipment enclosures. Clean all electrical equipment, including lighting fixtures, at time of Substantial Completion.
3. Refer to Division 1 for additional requirements.

3.3 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Install all equipment and systems according to manufacturer's recommendations, and as outlined in individual paragraphs of these documents, to provide complete and totally operational systems.

C. Comply with working clearances and dedicated spaces per NEC Article 110.

D. Mount all equipment on exterior walls and in damp and wet locations on steel channel support providing separation between equipment and mounting surface(s).

E. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

G. Right of Way: Give to piping systems installed at a required slope.

3.4 FIRESTOPPING

A. Firestop Systems for Electrical Low-Voltage Cabling Sleeves:

1. Provide for re-penetration of cables.
2. Smoke gaskets shall eliminate need for sealant or putty.
3. Hilti Firestop Speed Sleeves, Model CP653BA.

    a. Nominal size 2", with 1.7" inside diameter, 2.3" outside diameter, 4.7" flange, 12.4" length.
    b. Nominal size 4", with 3.6" inside diameter, 4.3' outisde diameter, 4.7" flange, 12.4" length.

3.5 FIELD QUALITY CONTROL

A. Conduct following tests on electrical installation during the course of construction:

1. Test conductors for grounds and shorts.
2. Test ground system.

3. Check all motors for proper rotation prior to coupling to equipment.
4. Test emergency system.
5. Test all ground fault protection equipment before temporary service is removed. Obtain test procedure from manufacturer and review procedure with Architect before conducting test.
6. Test phasing of switchboards and panelboards for compliance with NEC Article 408.
7. Test other systems as recommended by system manufacturer and as specified elsewhere.

B. Upon completion of the project:

1. Adjust voltage taps on all transformers for an optimum operating level.
2. Aim all adjustable lighting fixtures.
3. Adjust all auxiliary systems for optimum performance.
4. Measure load balance under near full-load conditions on all panelboards with true RMS reading meters, and reconnect loads as may be necessary to obtain reasonable balance of load between phases. Relabel affected equipment, devices, junction boxes, wiring, panelboard directories, etc., due to load reconnection and branch circuit number changes. Provide two (2) copies of final balance report indicating measured load current on each phase and neutral current for each panelboard.
5. Perform following tests and inspections, to verify tightness of connections, and prepare reports.

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of all electrical connections in switchgear, switchboards, panelboards, switches, circuit breakers, motor controls, busway, transformers, generators, transfer switches, etc., and each splice in cables and conductors for No. 3 AWG and larger, while carrying normal load. Remove front and rear covers of equipment and boxes so joints, splices, and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of 11 months after date of Substantial Completion.
    c. Instrument: Use an infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record device.
    d. Report: Prepare a certified report that identifies each piece of equipment checked and describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Bus Charger DC Power Cables.
3. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. DLO: Diesel Locomotive Cable.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

A. No submittals required.

B. Product Data: For each type of product.

C. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Certified field quality-control reports.

B. Length of cables for each feeder on project, including cabling to distribution equipment (switchboards, distribution panelboards, panelboards, busway, etc.). Branch circuits are not included in the requirement. Include both estimated length used for bidding and actual length installed, for use in short-circuit, coordination and arc flash hazard studies.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.
10. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 ASTM B 496 for stranded conductors.

E. Conductor Insulation:

1. Comply with NEMA WC 70/ICEA S-95-658.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type RHH and Type RHW-2: Comply with UL 44.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with UL 83.
6. Type XHHW-2: Comply with UL 44.

F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 BUS CHARGER DC POWER CABLES

A. Description: Heavy duty flexible power cable, insulated, drawn tinned copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 2000 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.
10. WESCO.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper, ASTM B33 for tinned annealed copper, and ASTM B172 for rope-lay-stranded copper conductors having bunch stranded members.

E. Conductor Insulation:

1. Comply with NEMA WC 70/ICEA S-95-658.
2. Type RHH/RHW-2: Comply with UL 44.
3. Type HDFPC-DLO: Comply with UL Subject 2806

F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. FCI - Burndy Products.
4. Gardner Bender.
5. Hubbell Power Systems, Inc.
6. Ideal Industries, Inc.
7. ILSCO.
8. NSi Industries LLC.
9. O-Z/Gedney; a brand of Emerson Industrial Automation.
10. Service Wire Co.
11. TE Connectivity Ltd.
12. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Duplex connectors for Type MC cable, permitting termination of (2) cables per fitting, are not acceptable.

E. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper or Aluminum as required for conductor material.
2. Type: One or Two hole with standard or long barrels as required.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Stranded copper for feeders smaller than No. 4 AWG; stranded copper or aluminum for feeders No. 4 AWG and larger. Conductors shown on drawings are sized as copper. Provide aluminum conductors with equivalent ampacity and impedance to copper conductors shown on drawings. Increased conductor, lug, and conduit fill sizing are responsibility of Electrical Contractor. Note that lugs must be suitable for aluminum regarding size and material.

B. Branch Circuits: Stranded copper.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type USE, single conductor in raceway.

B. Exposed Feeders: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, Type RHH/RHW-2, Type XHHW-2, single conductors in raceway.

H. VFC Output Circuits: Type XHHW-2 in metal conduit Type TC-ER cable with braided shield Type TC-ER cable with dual tape shield.

I. Bus Charger Output Power Circuits: Type 2kV HDFPC-DLO, RHH/RHW-2. Single cables in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Do not use conductors smaller than No. 12 AWG for branch circuit wiring.

B. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables. Install wiring after concrete and masonry work is complete and after moisture is swabbed from conduit.

D. Make conductor lengths for parallel feeders identical.

E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

F. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

G. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

H. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems." Secure cables at not more than 30 inch (760 mm) intervals, nor more than 6 inches (150 mm) from boxes, cabinets, racks, outlets, etc.

I. Lace or clip groups of feeder conductors at distribution centers, pull-boxes and wireways.

J. Use No. 10 AWG minimum wire size from panelboard to first outlet for any 277 volt branch circuit exceeding 125 feet between branch circuit panel and first outlet, and for any 120 volt branch circuit exceeding 75 feet between branch circuit panel and first outlet. Increase wire size one size for each additional 125 feet of length for any 277 volt branch circuit, and for each additional 75 feet of length for any 120 volt branch circuit, and adjust conduit size as required.

K. Based upon final feeder or branch circuit routing, up-size conductors to provide a maximum voltage drop of 2 percent for feeders and 3 percent for branch circuits, and a maximum voltage drop on both feeders and branch circuits of 5 percent, as described in NEC Articles 210.19A and 215.2A1 information notes.

L. De-rate branch circuit conductors for multiple home-runs sharing a single raceway per NEC Article 310.15B3.

M. Provide an individual neutral conductor for each phase conductor of branch circuits. Common neutral conductors are NOT allowed.

N. Provide separate neutral conductors for dimmer controlled lighting circuits.

O. Install only switch legs in conduits to switch boxes. Do NOT route power supply conductors through lighting switch boxes.

P. Install emergency system wiring in separate raceways from all other systems.

Q. Install receptacle and lighting circuits in separate raceways.

R. Install 208/120V and 480/277V circuits in separate raceways.

S. Make connections only in junction, pull and outlet boxes; terminal cabinets; and equipment enclosures.

T. Visually inspect, then test all feeders for grounds and short circuits prior to energizing the cable. Replace defective runs, or repair them at Architect's option.

3.4 INSTALLATION OF CABLES NOT ENCLOSED IN RACEWAY

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Install cables per manufacturer's recommendations without damaging conductors, shields, or jackets.

C. Install exposed cables parallel and perpendicular to building lines and surfaces of exposed structural members. Follow surface contours where possible.

D. Support cables according to Division 26 Section 260529 "Hangers and Supports for Electrical Systems." Secure cables at not more than 30 inch (760 mm) intervals nor more than 6 inches (150 mm) from boxes, cabinets, racks, outlets, etc.

E. Do not bend cables at less than 1.5 times manufacturer's recommended minimum bending radii.

F. Do not exceed manufacturer's recommended maximum pulling tensions.

G. Do not splice, tap, or terminate cables other than in outlets, terminals, or panels or cabinets.

H. Protect cables passing through metal studs, walls, etc., with suitable rubber grommets or conduit sleeves.

I. Separate unshielded voice, video, and data communication cables from EMI sources, power cables, transformers, and power equipment per TIA/EIA 569A requirements.

3.5 CONNECTIONS

A. Use screw on wire connector for copper conductor sizes No. 10 gauge and smaller except at motor connections. Use tool applied compression or split bolt type for all motor connections and for conductors larger than #10. Protect compression and split bolt type splices with suitable electrical tape.

B. Size all connectors to match cable size.

C. Use tools recommended by vendor for applying pressure connectors.

D. Suitable terminal lugs that are factory installed on equipment may be used for terminating cables.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

F. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

G. Splice only in accessible junction or outlet boxes.

H. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

a. Verify conductor and cable data matches drawing and specification requirements.
b. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
c. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

d. Inspect compression-applied connectors for correct cable match and indentation.
e. Inspect for correct identification.
f. Inspect cable jacket and condition.
g. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.

h. Continuity test on each conductor and cable.
i. Uniform resistance of parallel conductors.
j. Verify color coding meets specification requirements.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each connection or splice in conductors No. 3 AWG and larger. Remove box and equipment covers so connections or splices are accessible to portable scanner. Correct deficiencies determined during the scan.

   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies connections or splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each connection or splice 11 months after date of Substantial Completion.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
1. Ground rods.
2. Ground rings.
3. Grounding arrangements and connections for separately derived systems.

B. Certified field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
1) Ground rods.
2) Ground rings.

3) Grounding arrangements and connections for separately derived systems.

b. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning & Grounding.
7. ILSCO.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.
11. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
1. Stranded Conductors: ASTM B 8.
2. Tinned Conductors: ASTM B 33.
3. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

4. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of tin-plated annealed copper, 1/4 by 4 inches in cross section, 12 inches minimum length, with 9/32-inch holes spaced 1-1/8 inches apart for NEMA 2-hole connectors and insulators, wall-mounted steel mounting brackets, insulators and holes for NEMA 2-hole connectors and insulators, unless otherwise indicated. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V, and shall be Lexan or PVC, impulse tested at 5000 V.

1. Harger Series T-GBI-M for power grounding applications.
2. Harger Series GBI-TMGB for telecommunications grounding applications, with 12-inch or 24-inch length as indicated. Meet BICSI and EIA/TIA 607 Standards.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Underground Connectors: Cadweld exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions, or Burndy Hyground irreversible compression-type, UL listed, except in ground test wells which require heavy-duty UL listed, bolted connections.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Conduit Hubs: Mechanical type, terminal with threaded hub.

G. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

H. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

I. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

J. Straps: Solid copper, cast-bronze clamp copper lugs. Rated for 600 A.

K. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal one two-piece clamp.

L. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

M. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.

a. Material: Die-cast zinc alloy.
b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded or irreversible compression-type connectors except as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install at least three ground rods, separated by at least twenty (20) feet, and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install No. 4/0 AWG tinned-copper conductor for ground ring and for taps to equipment grounding terminals. Route taps in one inch (25 mm) nonmetallic conduit from two points on ground ring. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Water Heater: Install a separate insulated equipment grounding conductor to each electric water heater. Bond conductor to heater units, piping, connected equipment, and components.

C. Signal and Communication Equipment: For alarm, voice and data, and other communication equipment, provide one (1) No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch minimum grounding bus.
2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. After completion of individual ground rod resistance tests, interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three ground rods separated by at least twenty (20) feet from each other and located at least the same distance from other grounding electrodes, and interconnected with No. 4/0 AWG bare grounding conductors and from two points on grid to ground bus in service equipment.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Building Expansion Joints and Conduit Expansion Fittings: Install bonding jumper to maintain continuous ground continuity.
3. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
4. Use exothermic-welded or irreversible compression-type connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Grounding for Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.

1. Install No. 4/0 AWG tinned-copper conductor for ground ring and for taps to building columns.
2. Bury ground ring not less than 24 inches from building's foundation.

H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

c. Measurement of ground grid and building ground ring resistance must be accomplished using AVO Biddle's Slope Method where rods have been connected to grids or building ground rings prior to testing. If measurements do not meet requirements cited above, take corrective action as required. Re-measure grid resistance to ground until acceptable values are achieved.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Measured ground resistances shall not exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment and Raised Floor Systems: 1 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole, Building Ground Ring, and Fence Grounds: 5ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, install additional ground rods and conductors as required. Re-measure grid resistance to ground until acceptable values are achieved.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

1.3 ACTION SUBMITTALS

A. Delegated-Design Submittal: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch- diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. ERICO International Corporation.
d. Flex-Strut Inc..
e. GS Metals Corp.
f. G-Strut.
g. Haydon Corporation.
h. Metal Ties Innovation.
i. Thomas & Betts Corporation; A Member of the ABB Group.
j. Unistrut; Part of Atkore International.
k. Wesanco, Inc.

2. Standard: Comply with Metal Framing Manufacturer's Association Standard MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel and malleable-iron Stainless-steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Hilti, Inc..
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc..
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc..

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) B-line, an Eaton business.
        2) Empire Tool and Manufacturing Co., Inc..
        3) Hilti, Inc..
        4) ITW Ramset/Red Head; Illinois Tool Works, Inc..
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 105.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Support overhead electrical systems from building structural framing. Do NOT support electrical systems from roof decks, floor slabs, pipes, ducts, mechanical equipment, or other conduit, except as noted.

1. Electrical system support hanger loads less than 70 pounds may be suspended from floor slabs with preset inserts or approved anchors.
2. For concrete frame construction, electrical system support hanger loads less than 200 pounds may be suspended from floor or roof slabs with preset inserts or approved anchors.
3. If necessary, install appropriately sized steel support members spanning structural framing members to support electrical systems.

D. Do NOT support conduits or cables from suspended ceilings unless they are 1/2 inch or smaller trade size branch circuit conduits or cables that conform to NEC 300.11 and feed only equipment mounted in or on suspended ceiling.

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

H. Mounting straps for non-metallic conduit shall allow movement during expansion and contraction, yet secure conduit to structure.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: Use methods described in NECA 1.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that [meet][comply with seismic-restraint] strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with manufacturer’s installation requirements for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. For following systems:

1. Electrical power wiring.
2. Communications systems, including telephone and data.
3. Video distribution system.
4. Sound systems, including paging, intercom, sound reinforcement.
5. Security systems, including card access, video CCTV, door monitoring.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, tele-power poles, hinged-cover enclosures, and cabinets.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Allied Tube & Conduit; a part of Atkore International.
    c. Anamet Electrical, Inc.
    d. Calconduit.
    e. Electri-Flex Company.
    f. FSR Inc.
    g. Korkap.
    h. Opti-Com Manufacturing Network, Inc (OMNI).
    i. O-Z/Gedney; a brand of Emerson Industrial Automation.
    j. Patriot Aluminum Products, LLC.
    k. Perma-Cote.
    l. Picoma Industries, Inc.
    m. Plasti-Bond.
    n. Republic Conduit.
    o. Southwire Company.
    p. Thomas & Betts Corporation; A Member of the ABB Group.
    q. Topaz Electric; a division of Topaz Lighting Corp.
    r. Western Tube and Conduit Corporation.
    s. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.
    b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.
7. FMC: Comply with UL 1; zinc-coated steel.

8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Allied Tube & Conduit; a part of Atkore International.
    c. Anamet Electrical, Inc.
    d. Calconduit.
    e. Electri-Flex Company.
    f. FSR Inc.
    g. Korkap.
    h. Opti-Com Manufacturing Network, Inc (OMNI).
    i. O-Z/Gedney; a brand of Emerson Industrial Automation.
    j. Patriot Aluminum Products, LLC.
    k. Perma-Cote.
    l. Picoma Industries, Inc.
    m. Plasti-Bond.
    n. Republic Conduit.
    o. Southwire Company.
    p. Thomas & Betts Corporation; A Member of the ABB Group.
    q. Topaz Electric; a division of Topaz Lighting Corp.
    r. Western Tube and Conduit Corporation.
    s. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

    a. Material: Steel. Die cast type are not allowed.
    b. Type: Setscrew.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
9. Bushings: Impact resistant plastic, 105 deg C rated. Grounding type shall be insulated steel with proper ground lug.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.
    e. CertainTeed Corporation.
    f. Champion Fiberglass, Inc.
    g. Condux International, Inc.
    h. Electri-Flex Company.
    i. FRE Composites.
    j. Kraloy.
    k. Lamson & Sessions.
    l. Niedax Inc.
    m. RACO; Hubbell.
    n. Thomas & Betts Corporation; A Member of the ABB Group.
    o. Topaz Electric; a division of Topaz Lighting Corp.
    p. United Fiberglass.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:

    a. Comply with NEMA TC 14.
    b. Comply with UL 2515 for aboveground raceways.
    c. Comply with UL 2420 for belowground raceways.

4. RNC: Type EPC-40-PVC and EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

    a. Utilize PVC coated rigid steel conduit elbows for sizes 1-1/4 inch and larger, unless phase conductors are indicated to be installed in separate conduits.

5. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.

e. CertainTeed Corporation.
f. Champion Fiberglass, Inc.
g. Condux International, Inc.
h. Electri-Flex Company.
i. FRE Composites.
j. Kraloy.
k. Lamson & Sessions.
l. Niedax Inc.
m. RACO; Hubbell.
n. Thomas & Betts Corporation; A Member of the ABB Group.
o. Topaz Electric; a division of Topaz Lighting Corp.
p. United Fiberglass.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.
2. Hoffman; a brand of Pentair Equipment Protection.
3. Lamson & Sessions.
4. Niedax Inc.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Cutler-Hammer; Eaton Corporation.
3. Crouse-Hinds, an Eaton business.
4. EGS/Appleton Electric.
5. Erickson Electrical Equipment Company.
6. FSR Inc.
7. General Electric Co.; Electrical Distribution & Control Division.
8. Hoffman; a brand of Pentair Equipment Protection.
9. Hubbell Incorporated.
10. Hubbell Incorporated; Wiring Device-Kellems.
11. Kraloy.
12. Milbank Manufacturing Co.
13. MonoSystems, Inc.
14. Oldcastle Enclosure Solutions.
15. O-Z/Gedney; a brand of Emerson Industrial Automation.
16. Plasti-Bond.
17. RACO; Hubbell.

18. Siemens Energy & Automation, Inc.
19. Spring City Electrical Manufacturing Company.
20. Square D; Group Schneider.
21. Stahlin Non-Metallic Enclosures.
22. Thomas & Betts Corporation; A Member of the ABB Group.
23. Topaz Electric; a division of Topaz Lighting Corp.
24. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloyaluminum, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable Semi-adjustable.
3. Shape: Rectangular, unless otherwise indicated.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum galvanized, cast iron with gasketed cover.

J. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

K. Device Box Dimensions: 4 inches square by 2-1/8 inches deep Insert dimension.

L. Gangable boxes are prohibited.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic Fiberglass.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, Type 1, unless otherwise indicated, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel, sized as indicated on Drawings.
2. Hinged door in front cover with flush latch and concealed hinge and screws. Size door to allow access to terminals without removing cover.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Plywood backboard, 3/4 inch (19 mm) thick, finished with fire retardant sealer.
6. Terminal Strips

    a. Below 50 volts: Screw terminal type.
    b. 51 to 250 volts: 250 volt screw terminal type with barrier between each set of terminals and individual terminal points for each conductor.
    c. 251 to 600 volts: 600 volt terminal strips similar to (b) above.

7. Accessory feet where required for freestanding equipment.
8. Identification

    a. Identify terminal strips with permanent numbers.

9. Wiring Diagrams

    a. Provide wiring diagram on inside of each cabinet door showing units and conductors connected to cabinet.

2.6 HANDHOLES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes:

1. Handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Precast Concrete Handholes and Boxes: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Advance Concrete Products
    b. Hartford Concrete Products
    c. Or approved equal.

2. Standard: Comply with ASTM C1037.
3. Structural Design: AASHTO HS 20 wheel loading.

4. Configuration: Units must be designed for flush burial and have closed bottom unless otherwise indicated.
5. Frame and Cover: Per City of Madison standard.
6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at installation location with ground-water level at grade.
7. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus additional 12 inch vertically and horizontally to accommodate alignment variations. Refer to plans for dimensions.
8. Handholes must have inserts for cable racks and pulling-irons installed before concrete is poured.

C. Polymer-Concrete Handholes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Quazite: Hubbell Power Systems, Inc.
   b. Or approved equal.

2. Standard: Comply with SCTE 77.
3. Size: As indicated on Drawings
4. Load Rating: UL listed and labeled for Tier 10 loading, with 10,400 lb. design load and 22,568 lb. minimum test load.
5. Color of Frame and Cover: Gray.
6. Configuration: Designed for flush burial with two (2) stackable sections and open bottom unless otherwise indicated.
7. Cover: Weatherproof, gasketed, secured by stainless-steel, tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
8. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
9. Cover Legend: Molded lettering, "ELECTRIC.", "COMMUNICATIONS", or other lettering as required by type of cables being installed.
10. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
11. Handholes 12 Inches Wide by 24 Inches Long Insert dimensions and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 BACKBOARDS FOR TERMINATION OF SYSTEMS WIRING

A. Description: 3/4 inch (19.1 mm) thick, exterior type, A-C grade plywood. Provide one (1) 4 foot by 8 foot piece per location, unless otherwise shown on Drawings.

B. Finish: Two (2) coats of UL listed fire-retardant paint.

2.8 WALLPLATES

A. To match other wiring device wallplates. Refer to Section 262726 “Wiring Devices.”

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit, Not Subject to Physical Damage: GRC, IMC, RNC, Type EPC-40-PVC RNC, Type EPC-80-PVC.
2. Exposed Conduit, Subject to Physical Damage: GRC, IMC, RNC, Type EPC-80-PVC.
3. Concealed Conduit, Aboveground: GRC IMC RNC, Type EPC-40-PVC.
4. Covered Locations, Open to Exterior: GRC, IMC.
5. Exposed Conduit, Parking Ramps and Garages: RNC, Type EPC-80-PVC.
6. Underground Conduit:

    a. RNC, Type EPC-40-PVC Type EPC-80-PVC, direct buried.
    b. RNC, Type EPC-40-PVC in concrete on grade
    c. Type EB-20 for concrete encased duct bank.

7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
8. Exposed Boxes and Enclosures, Aboveground: NEMA 250, Type 4. Rigid PVC construction with suitable covers, UL rated for 90 degree conductors.
9. Boxes Flush Mounted in Building Walls, Exterior Side: Weatherproof cast aluminum outlet box, gasketed extension as required, plugs for all unused openings, ground screw mounting lugs, zinc die-cast weatherproof cover, grey finish.
10. Terminate PVC conduit prior to entering building in suitable PVC-to-rigid steel conduit adaptor fitting.
11. Handholes for Underground Wiring:

    a. Handholes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete units, SCTE 77, Tier 15 structural load rating.
    b. Handholes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
    c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77, (13 345-N) Tier 5 structural load rating.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit, Not Subject to Physical Damage: EMT.

2. Exposed Conduit, Subject to Physical Damage: GRC or IMC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

3. For Supporting Lighting Fixtures: GRC or IMC.
4. Circuits over 600 Volts: GRC or IMC, except where RNC is specified.
5. Hazardous Locations: GRC or IMC.
6. Conduit in All Concrete, Except Concrete on Grade: GRC.
7. Conduit Concealed in Ceilings and Interior Walls and Partitions: EMT.
8. Connection to Recessed Lighting Fixtures: FMC, except use LFMC in damp or wet locations.
9. Connection to Vibrating Equipment Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment: LFMC, except use FMC in dry locations for 120 volt motors 1/3 HP or less. Provide only sufficient length of flexible conduit necessary to avoid transmission of vibrations.
10. Conduit, Damp or Wet Locations: GRC or IMC.
11. Boxes and Enclosures, Indoor Dry Locations: NEMA 250, Type 1, hot dip galvanized construction or cadmium plated, pressed sheet steel, blanked for conduit, attached lugs for mounting, full access screw-on or hinged cover. Provide flush mounted boxes with overlapping cover with flush-head cover retaining screws, prime coated.

    a. Ceiling Outlet Boxes, Flush or Surface Mounted: 4 inch by 2-1/8 inch deep (102 mm x 54 mm deep), octagonal boxes for receiving three or less 1/2 in. (12 mm) conduits.
    b. Wall Outlet Boxes, Flush Mounted, Gypsum Wallboard

        1) 4 inch by 2-1/8 inch deep (102 mm x 54 mm) square boxes with matching square-drawn/tile cover for single or two (2) gang outlets.
        2) 4-11/16 inch by 2-1/8 inch deep (119 mm x 54 mm) square boxes with matching square-drawn/tile covers for single or two (2) gang outlets. Use for all 1 inch or 1-1/4 inch conduit entries.
        3) 2-1/2 inches deep (64 mm) gangable switch boxes at wall switch locations.
        4) 4 inch by 3-1/2 inch deep (102 mm x 89 mm) square boxes with matching square-drawn/tile cover for single or two (2) gang outlets. Use for all communication/data outlets, unless wall thickness dictates shallower box.

    c. Wall Outlet Boxes, Flush Mounted, Masonry: 3-1/2 inches (89 mm) deep masonry boxes, single or multiple gang, as required or as indicated on the Drawings.
    d. Wall Outlet Boxes, Surface Mounted: 4 inches by 2-1/8 inches deep (102 mm x 54 mm) square.

12. Outlet Boxes, Indoor Damp or Wet Locations, Equipment connections in Shops: NEMA 250, Type 4. Type FD (deep) or FS (shallow) cast device box, copper-free aluminum, blank body for drilling and tapping of required openings, gasketed extension as required, ground screw, aluminum gasketed, wet location cover, stainless steel screws.
13. Outlet Boxes, Flush Mounted in Building Walls, Exterior Side: Weatherproof cast aluminum outlet box, gasketed extension as required, plugs for all unused openings, ground screw, mounting lugs, zinc die-cast weatherproof cover, grey finish.
14. Boxes and Enclosures, Exterior Locations: Rigid PVC construction with suitable covers, UL rated for 90° conductors.

    a. Wall Outlet Boxes: "FS" type, rigid PVC, UL rated for 90° conductors, or malleable iron. Die cast "Bell" boxes will not be allowed.

C. Minimum Raceway Size: 1/2-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use set-screw, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION OF RACEWAYS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports. Mount exposed conduits tight to walls. Provide offsets at boxes and equipment.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Coordinate installation of raceways in masonry and concrete with construction process.

D. Route conduit to avoid structural obstructions, minimizing crossovers.

E. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

F. Do not fasten conduits onto the bottom side of a metal deck roof.

G. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes and other heat sources. Install horizontal raceway runs above water and steam piping.

H. Install conduit free from dents and bruises. Plug ends to prevent entry or dirt or moisture.

I. Complete raceway installation and clean out raceway before starting conductor installation.

J. Arrange stub-ups so curved portions of bends are not visible above finished slab.

K. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

L. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

M. Conceal conduit within finished walls, ceilings, and floors, excluding overhead in rooms without finished ceilings, mechanical equipment rooms, connections to motors, and connections to surface panelboards, unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

N. Support conduit within 12 inches of enclosures to which attached.

O. Route all exposed conduits and conduits above dropped ceilings parallel or perpendicular to building lines. Locate as close to building surfaces or structure as possible.

P. Do NOT install conduit horizontally in slabs except where indicated on Drawings.

Q. Locate each conduit through roof separate sleeve provided under Division 7. Do NOT locate raceways in sleeves with other pipes. Coordinate all roof penetrations with roofing installation. Arrange raceways to cross expansion joints at right angles.

1. Install UL approved expansion fittings, complete with grounding jumpers, where metallic conduits cross building expansion joints.

R. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

S. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

T. Install bushings on all conduit terminations, except where insulated throat connectors are used. Use insulated steel type bushings where grounding or bonding is required. Use plastic type bushings at other locations.

U. To avoid conductor derating and mutual heating, do NOT group conduits in earth. Separate conduits immediately after leaving equipment.

V. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

W. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

X. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

Y. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Z. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

AA. Install pull wires in all empty and/or spare raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap all empty and/or spare raceways and install identification tags. Cap underground raceways designated as spare above grade alongside raceways in use.

BB. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

CC. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

DD. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

EE. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

FF. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

GG. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

HH. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

II. Seal around all conduits through walls and floors to maintain fire and smoke rating and prevent sound transmission.

3.3 INSTALLATION OF BOXES AND CABINETS

A. Conceal all pull boxes and junction boxes wherever possible. Mount boxes flush in all areas other than mechanical rooms, electrical rooms, and above removable ceilings.

B. Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms, or storage areas to permit access to interior of the box.

C. Size pull boxes and junction boxes to provide ample room for conductors, cable bends, and terminations where applicable. Utilize NEC as minimum sizing guide only.

D. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.

E. Coordinate locations and mounting heights of outlets mounted above counters with built-in units, window sills, heating/cooling equipment, etc., prior to installation. Adjust outlet mounting height to agree with required location for equipment served.

F. Recessed Boxes in Masonry Walls: Coordinate cutting of masonry walls to achieve neat openings for boxes. Adjust position of outlets in finished masonry walls to suit masonry course lines. Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

G. Do NOT install boxes back-to-back in opposite sides of same wall or partition. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Do NOT use through-the-wall type boxes.

H. Locate boxes so that cover or plate will not span different building finishes.

I. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

J. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

K. Do NOT use sectional or handy boxes unless specifically requested.

L. Verify that there is insulation behind boxes mounted in exterior walls to prevent condensation in boxes.

M. Mount all outlet boxes plumb and parallel with door or window frames, countertops and other building lines.

N. Identify all conductors within pull boxes and junction boxes per Section 260553 - “Identification for Electrical Systems”.

O. Refer to Section 260500 - “Common Work Results for Electrical for openings in fire-rated walls, partitions, floors, and ceilings.

P. Securely anchor all fittings and boxes.

Q. Install one (1) 3/4 inch conduit in floor slab from low voltage compartment of each floor box to accessible ceiling plenum, unless noted otherwise.

R. Mount cabinets on, or in, wall with top of box no higher than 72 inches above floor.

S. Terminate conduit in cabinets with lock nut and bushing or lock nut and grounding bushing.

T. Terminate wiring in cabinets on terminal blocks or strips.

U. Vacuum clean cabinets on completion of installation.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
8. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.5 INSTALLATION OF UNDERGROUND HANDHOLES

A. Excavate sufficient material to provide sufficient space for installation of handhole and to perform work in satisfactory manner.

B. Install handholes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

C. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

D. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

E. Install handholes with bottom below frost line.

F. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

G. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

H. Install drains in bottom of handholes where indicated.

I. Apply waterproofing to exterior surfaces of pre-cast concrete handholes. After ducts has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars.

J. Ground handhole per Section 260526 - "Grounding and Bonding for Electrical Systems."

K. Plug all openings to prevent infiltration or leakage.

L. Provide two (2) entry tools for tamper resistant hardware.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 RACEWAY SYSTEMS FOR COMMUNICATIONS, VIDEO DISTRIBUTION, SOUND, AND SECURITY SYSTEMS WIRING.

A. Equipment and wiring will be installed under separate contract by Owner’s Special System Contractors.

B. Provide all raceway components, including cabinets, terminal boards, surface raceways, backboxes, baffles, conduit and boxes, as required to form a complete empty raceway system. Extend conduits and/or surface raceways to nearest accessible system cabinet, backboard, or terminal room.

C. Each run of conduit shall contain not more than two 90 degree bends and no run shall exceed 100 ft. in length. Minimum radii for bends: 9-1/2 inches for 3/4 inch conduit, 10-1/2 inches for 1 inch conduit, and a minimum of ten times the trade size diameter bends for larger sizes. Do NOT use conduit fittings in lieu of bends.

D. Provide bushed fittings on all conduit terminations.

E. Provide pullboxes in conduit runs exceeding 100 ft. (30 m) in length, and in runs with more than two right angle bends. Do NOT use conduit fittings in lieu of bends.

F. Identify all cabinets, and pull and junction boxes as to system usage.

G. Provide nylon pull cord in each conduit run.

H. Provide identification tags on all conduit runs.

I. Provide cover plates on all outlet boxes.

J. Provide plywood backboards and duplex receptacles in equipment room(s). Confirm location on job-site prior to installation. Paint all backboards with prime coat of fire resistant paint and finish coat of enamel in color to match wall. In unfinished rooms, provide gray finish coat.

K. Coordinate all work with Owner and Owner's Special System Contractor.

L. Provide underground conduit to property line for utility service entrance. Verify exact location with serving utility. Refer to Drawings for details.

END OF SECTION 260533

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:
1. Section 260500 "Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:
1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
   b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. CALPICO, Inc.
   c. Metraflex Company (The).
   d. Pipeline Seal and Insulator, Inc.
   e. Proco Products, Inc.

2. Sealing Elements: EPDM Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel Plastic Stainless steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
   1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
   5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels for equipment, wiring devices, control stations, etc.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.
10. Panelboard directories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with OSHA Specifications for accident prevention signs contained in the Code of Federal Regulations as 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Power Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for service feeder and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.

3. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Gray.

4. Color for Equipment Grounds: Green.
5. Colors for Isolated Grounds: Green with white stripe.

C. Raceways and Cables Carrying Power Circuits at More Than 600 V:

1. Black letters on an orange field.

2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
3. High Voltage Warning: "WARNING - HIGH VOLTAGE - KEEP OUT".

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Champion America.
c. emedco.
d. Grafoplast Wire Markers.
e. HellermannTyton.
f. LEM Products Inc.
g. Marking Services, Inc.
h. Panduit Corp.
i. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. HellermannTyton.
c. Marking Services, Inc.
d. Panduit Corp.
e. Seton Identification Products.

C. Self-Adhesive Wraparound Labels: Preprinted Write-on, 3-mil- thick, polyester vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A'n D Cable Products.
    b. Brady Corporation.
    c. Brother International Corporation.
    d. emedco.
    e. Grafoplast Wire Markers.
    f. Ideal Industries, Inc.
    g. LEM Products Inc.
    h. Marking Services, Inc.
    i. Panduit Corp.
    j. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester Vinyl, thermal, transfer-printed, 3-mil- thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A'n D Cable Products.
    b. Brady Corporation.
    c. Brother International Corporation.
    d. emedco.
    e. Grafoplast Wire Markers.
    f. HellermannTyton.
    g. Ideal Industries, Inc.
    h. LEM Products Inc.
    i. Marking Services, Inc.
    j. Panduit Corp.
    k. Seton Identification Products.

2. Minimum Nominal Size:

    a. 1-1/2 by 6 inches for raceway and conductors
    b. 3-1/2 by 5 inches for equipment.
    c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. HellermannTyton.
    c. Marking Services, Inc.
    d. Panduit Corp.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Carlton Industries, LP.
    b. Champion America.
    c. HellermannTyton.
    d. Ideal Industries, Inc.
    e. Marking Services, Inc.
    f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.

C. Tape and Stencil: 4-inch- wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. HellermannTyton.
b. LEM Products Inc.
c. Marking Services, Inc.
d. Seton Identification Products.

D. Floor Marking Tape: 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Seton Identification Products.

E. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Ideal Industries, Inc.
c. LEM Products Inc.
d. Marking Services, Inc.
e. Reef Industries, Inc.
f. Seton Identification Products.

2. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape shall be permanent and shall not be damaged by burial operations.
c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

3. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE" .
c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

4. Tag:

    a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright yellow-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    b. Width: 3 inches.
    c. Overall Thickness: 5 mils.
    d. Foil Core Thickness: 0.35 mil.
    e. Weight: 28 lb/1000 sq. ft..
    f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Marking Services, Inc.
    e. Seton Identification Products.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened printed permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Brady Corporation.
    b. Carlton Industries, LP.
    c. emedco.
    d. Grafoplast Wire Markers.
    e. LEM Products Inc.
    f. Marking Services, Inc.
    g. Panduit Corp.
    h. Seton Identification Products.

C. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. LEM Products Inc.
c. Seton Identification Products.

2. Polyester Tags: 0.010 inch Insert dimension thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
4. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Champion America.
c. emedco.
d. Marking Services, Inc.

2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Champion America.
c. emedco.
d. Marking Services, Inc.

2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.

b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.

2. Engraved legend.
3. Thickness:

a. For signs up to 20 sq. in., minimum 1/16 inch thick.
b. For signs larger than 20 sq. in., 1/8 inch thick.

4. Engraved legend with black letters on white face. Emergency panels shall have white letters on red face.
5. Minimum letter height shall be 3/4 inch (10 mm) unless otherwise indicated.
6. Permanent self-adhesive.
7. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

C. Device Plate Labels: Permanent self-adhesive backed, 3/8 inch (10 mm) wide, clear heavy-duty acrylic tape with machine printed 1/4 inch (6 mm) high black letters. Impression letters on plastic tape are not acceptable.

D. Underground Line Concrete Markers: 12 inches square by 4 inches thick concrete, chamfered top edges, arrows with stamped legend indicating route and type of underground line.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

E. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Self-Adhesive Identification Products: Clean surfaces before application using materials and methods recommended by manufacturer of identification device.

H. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

I. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

J. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer or load shedding.

M. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

N. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

X. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

Y. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized and plenum-rated cable ties.

Z. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized and plenum-rated cable ties.

AA. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized and plenum-rated cable ties.

BB. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on minimum 1-1/2-inch- high sign; where two lines of text are required, use signs minimum 2 inches high.

CC. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

DD. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high sign; where two lines of text are required, use labels 2 inches high.

EE. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.

1. Locate identification at changes in direction, at both sides of penetrations of walls and floors, at 30-foot maximum intervals in straight runs, and at 15-foot maximum intervals in congested areas.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase. Locate at each load or terminal connection in control panels and panelboard gutters. Use self-adhesive wraparound labels to identify source, circuit number, and voltage of each set of conductors.

E. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation. Identify source, circuit number, and voltage of each set of conductors.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination. Handwritten lettering is not acceptable. For wires of different systems in common boxes, group each cable with its own system and identify each cable to indicate appropriate system.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation. Include wire number or terminal number from schematic, or interconnection diagrams on installation or shop drawings.

H. Motor Control Labels: Provide typed label inside each motor starter, adjustable frequency drive, etc., including those furnished by other divisions, identifying motor served, horsepower, voltage, phase, full-load current, code letter, and design letter.

I. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

J. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

K. Junction and Pull Box Identification: Stencil or neatly identify with permanent marker all junction and pull boxes as follows:

1.	Lighting and Power enclosed including panelboard names	-	208V, 240V or 480V, circuit numbers
2.	Data	-	DAT
3.	Television	-	TV
4.	Sound Reinforcement	-	SR
5.	Paging	-	PA
6.	Intercom	-	IC
7.	Emergency	-	E (white letters on red background)

L. Empty and/or Spare Raceways: Install identification tag stamped to indicate conduit destination and future use, i.e., sound, telephone, electric, etc.

M. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
   1. Install underground-line warning tape for direct-buried cables and cables in raceways.
   2. During construction, provide temporary identification of underground raceways and direct-buried cable routings by means of marker flags located directly above and along entire length of raceway and wiring.

N. Workspace Indication: Apply floor marking tape tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

      a. Power-transfer switches.
      b. Controls with external control power connections.

   3. For equipment requiring workspace clearance according to NFPA 70, apply to door or cover of equipment, but not on flush panelboards and similar equipment in finished spaces, unless noted otherwise.

Q. Warning Labels for High Voltage Equipment and Boxes: Locate on entrance doors to each electrical room containing high voltage equipment, on each primary switch, on each unit substation, on each padmount transformer and on each junction box containing high voltage cable.

R. Arc Flash Warning Labeling: Self-adhesive labels.

   1. Comply with NFPA 70E and ANSI Z535.4.
   2. Comply with Section 260574 "Overcurrent Protective Device Arc-Flash Study" requirements for arc-flash warning labels.

S. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

T. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer load shedding.

U. Equipment Identification Labels:

   1. Label all equipment.

2. Utilize unique designation that is consistent with drawings, wiring diagrams, schedules, and operation and maintenance manual. Include equipment type, e.g.: UNIT SUB, MCC, DP, SWBD, ATS, XFMR, PNL, BUSWAY, FIRE ALARM, PA, PAGING, ACCESS CONTROL, NURSE CALL, etc.
3. Verify all equipment names with Owner and Engineer prior to making labels.
4. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system.
5. Systems include power, lighting, control, communication, signal, monitoring, and alarm, unless equipment is provided with its own identification.
6. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Impression letters on plastic tape will not be allowed. Unless otherwise indicated, provide a single line of text with 3/4 inch-high letters on 1-1/2 inch-high label; where additional lines of text are required, increase label height proportionally.
7. Outdoor Equipment: Stenciled legend 4 inches high.
8. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
9. Equipment to Be Labeled, shall include, but not be limited to, the following:

    a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    b. Enclosures and electrical cabinets.
    c. Access doors and panels for concealed electrical items.
    d. Switchboards.
    e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    f. Busway.
    g. Emergency system boxes and enclosures.
    h. Enclosed switches.
    i. Enclosed circuit breakers.
    j. Enclosed controllers.
    k. Variable-speed controllers.
    l. Push-button stations.
    m. Power-transfer equipment.
    n. Contactors.
    o. Remote-controlled switches, dimmer modules, and control devices.
    p. Time switches.
    q. Battery-inverter units.
    r. Power-generating units.
    s. Monitoring and control equipment.
    t. UPS equipment.
    u. Voice and data cable terminal equipment.
    v. Paging system equipment.
    w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
    x. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

10. Identify equipment on inside of cover of flush panels and on outside of cover of surface panels as follows:

    a. Lighting and Power Panels (black letters on white background) - PANEL DESIGNATION (3/4 inch high letters), VOLTAGE (1/4 inch high letters), SOURCE PANEL FEEDING THIS PANEL AND OWNER'S ROOM NUMBER WHERE SOURCE PANEL IS LOCATED (1/4 inch high letters).
    b. Communications Cabinets - TELEPHONE OR OTHER USAGE (paging, etc.).
    c. Data Cabinets - DATA.
    d. Emergency Panels (white letters on red background) - EMERGENCY PANEL DESIGNATION (3/4 inch high letters), VOLTAGE (1/4 inch high letters), SOURCE PANEL FEEDING THIS PANEL AND OWNER'S ROOM NUMBER WHERE SOURCE PANEL IS LOCATED (1/4 inch high letters).

11. Identify each main breaker or switch (primary and secondary) in all distribution equipment with laminated label similar to above.
12. Equip each branch device in all distribution panelboards, switchboards, motor control centers, busway, unit-substations, etc., with laminated label similar to above. Identify load served and location of load. Use identifications compatible with Owner's program. For adjustable-trip circuit breakers, identify trip setting.

    a. Identify all control devices, circuit breakers, disconnect switches, motor starters, contactors, time switches, test switches, etc, including those furnished by other divisions or with pre-purchased equipment, with equipment fed and Owner's room number where equipment is located, source panel or equipment feeding this device, and Owner's room number where source panel or equipment is located. Height of label may be decreased where mounting space for label is limited.

V. Panelboard Directories:

1. Equip each branch circuit panelboard with typewritten or computer generated directory accurately indicating Owner's room number and equipment name being served.
2. Use identifications compatible with Owner's program, and readily identifiable without removing directory from its holder.

W. Device Plate Identification

1. Engrave device plates of all receptacles on emergency electrical system with word "EMERGENCY" , and on isolated ground system with words "ISOL.GND"• . Separate nameplates secured to device plate are not acceptable.
2. Label device plates of all wall switches, receptacles, control stations, etc., indicating source, panel name, and circuit.

    a. Label device plates of all wall switches, control stations, volume controls, etc., with permanent adhesive indicating equipment controlled.

END OF SECTION 260553

SECTION 260572 - OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices and short-circuit current rating of all distribution equipment.

B. Based upon study results, select and furnish all distribution equipment, and set all protective devices, to provide the following:

1. Short-circuit current ratings equal to or greater than the available short-circuit current, as determined by this study, or equal to the interrupting rating shown in the specifications or on the Drawings, whichever is greater.
2. Coordination of the short-circuit protection per N.E.C. Article 240.12.
3. Protection from damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions per N.E.C. Article 240.4 and ICEA P-32-382.
4. Coordination of ground-fault protection for service and disconnecting means in healthcare facilities per N.E.C. Article 517.17B.
5. Selective coordination of all overcurrent protective devices for emergency systems and legally required standby systems per N.E.C. Articles 700.28 and 701.27.
6. Protection from damaging temperatures in transformers under overcurrent conditions.
7. Selective coordination of all overcurrent protective devices for more than one elevator supplied by a single feeder per N.E.C. Article 620.62.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following simultaneously with or prior to the distribution system protective devices submittals. Submittals may be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.
2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action concurrent with or prior to the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

3. Revised layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to selections of overcurrent protective devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor designations and kVA ratings.
5. Switchgear, switchboard, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. Calculated asymmetrical fault currents:

        1) Based on fault-point X/R ratio.
        2) Based on calculated symmetrical value multiplied by 1.6.
        3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

    a. Voltage.
    b. Calculated symmetrical fault-current magnitude and angle.
    c. Fault-point X/R ratio.
    d. No AC Decrement (NACD) ratio.
    e. Equivalent impedance.
    f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
    g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility maximum available fault current and impedance at the service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
8. Motor horsepower and NEMA MG 1 code letter designation.
9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.2 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. The extent of the electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

F. Study electrical distribution system from normal power source throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and shall apply to low-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.
2. Low-voltage switchgear.
3. Switchboards.
4. Distribution panelboards.
5. Control panels.
6. Branch circuit panelboards.
7. Disconnect switches.
8. Motor controllers.

3.3 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.4 LABELING

A. Label all new equipment and all equipment feeding new equipment with maximum available fault current per N.E.C. Article 110.24.

3.5 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION 260572

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

B. Based upon study results, select and furnish all distribution equipment, and set all protective devices, to provide the following:

1. Coordination of the short-circuit protection per N.E.C. Article 240.12.
2. Protection from damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions per N.E.C. Article 240.4 and ICEA P-32-382.
3. Coordination of ground-fault protection for service and disconnecting means in healthcare facilities per N.E.C. Article 517.17B.
4. Selective coordination of all overcurrent protective devices for emergency systems and legally required standby systems per N.E.C. Articles 700.28 and 701.27.
5. Protection from damaging temperatures in transformers under overcurrent conditions.
6. Selective coordination of all overcurrent protective devices for more than one elevator supplied by a single feeder per N.E.C. Article 620.62.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following simultaneously with or prior to the distribution system protective devices submittals. Submittals may be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.

    1. Submit study report for action concurrent with or prior to the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

4. Revised layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to short-circuit current ratings and selections of overcurrent protective devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Coordination Study Specialist Field Adjusting Agency.

B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For the overcurrent protective devices to include in operation, maintenance manuals, and the following:

1. The following parts from the Protective Device Coordination Study Report:

    1. One-line diagram.
    2. Protective device coordination study.
    3. Time-current coordination curves.

2. Power system data.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Coordination Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Coordination Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

1. Arcing faults.
2. Simultaneous faults.
3. Explicit negative sequence.
4. Mutual coupling in zero sequence.

2.2 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor designations and kVA ratings.
5. Switchgear, switchboard, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study:

1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.

    1. Phase and Ground Relays:

        1. Device tag.
        2. Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
        3. Recommendations on improved relaying systems, if applicable.

    2. Circuit Breakers:

        1. Adjustable pickups and time delays (long time, short time, ground).
        2. Adjustable time-current characteristic.
        3. Adjustable instantaneous pickup.
        4. Recommendations on improved trip systems, if applicable.

    3. Fuses: Show current rating, voltage, and class.

G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes. Show the following information:

1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:

    1. Power utility's overcurrent protective device.
    2. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    3. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.

4. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
5. Cables and conductors damage curves.
6. Ground-fault protective devices.
7. Motor-starting characteristics and motor damage points.
8. The largest feeder circuit breaker in each motor-control center and panelboard.

5. Provide adequate time margins between device characteristics such that selective operation is achieved.
6. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

E. Study electrical distribution system from normal power source throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

1. Inrush current when first energized.
2. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
3. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

G. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

I. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and shall apply to low-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

J. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:

1. Electric utility's supply termination point.
2. Low-voltage switchgear.
3. Switchboards.
4. Distribution panelboards.
5. Control panels.
6. Branch circuit panelboards.
7. Motor controllers.

K. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear, switchboard, and panelboard bus bars to withstand short-circuit stresses.

3.3 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:

1. Determine load-flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
2. Determine load-flow and voltage drop based on 80 percent of the design capacity of the load buses.
3. Prepare the load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.4 MOTOR-STARTING STUDY

A. Perform a motor-starting study to analyze the transient effect of the system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of the motor starting on the power system stability.

B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141 and voltage sags so as not to affect the operation of other utilization equipment on the system supplying the motor.

3.5 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.

1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.
2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Electrical power utility maximum available fault current and impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Maximum demands from service meters.
12. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
13. Motor horsepower and NEMA MG 1 code letter designation.
14. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
15. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

1. Special load considerations, including starting inrush currents and frequent starting and stopping.
2. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
3. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
4. Ratings, types, and settings of utility company's overcurrent protective devices.
5. Special overcurrent protective device settings or types stipulated by utility company.
6. Time-current-characteristic curves of devices indicated to be coordinated.
7. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
8. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
9. Panelboards, switchboards ampacity, and SCCR in amperes rms symmetrical.
10. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Revise layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to short-circuit current ratings and selections of overcurrent protective devices.

D. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.

2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573

SECTION 260574 - OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following simultaneously with or prior to the distribution system protective devices submittals. Submittals may be in digital form.

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action concurrent with or prior to the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
b. Revised single-line diagram, reflecting field investigation results and results of arc-flash study.

3. Revised layouts for electrical rooms that require adjustments due to changes in distribution equipment sizes related to selections of overcurrent protective devices.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Arc-Flash Study Specialist Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.
2. Operation and Maintenance Procedures: Provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide software by one of the following:

1. ESA Inc.
2. Operation Technology, Inc.
3. Power Analytics, Corporation.
4. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary.

B. Study descriptions, purpose, basis and scope.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor designations and kVA ratings.
5. Switchgear, switchboard, and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output: As specified in "Short Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."

F. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

G. Arc-Flash Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

2.3 ARC-FLASH WARNING LABEL

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies:

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260572 "Overcurrent Protective Device Short-Circuit Study."
2. Protective Device Coordination Study Report Contents: As specified in "Protective Device Coordination Study Report Contents" Article in Section 260573 "Overcurrent Protective Device Coordination Study."

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include low-voltage equipment locations.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on the one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to the attention of Architect.

2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility maximum available fault current and impedance at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus, three phase and line-to-ground.
5. Full-load current of all loads.
6. Voltage level at each bus.
7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in per cent, and phase shift.
8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
10. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
11. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
12. Motor horsepower and NEMA MG 1 code letter designation.
13. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Label all new equipment with its associated arc-flash hazard warning per N.E.C. Article 110.16.

B. Equipment to be labeled shall include, but not be limited to the following:

1. Motor-controllers.
2. Low-voltage switchboards.
3. Panelboards.
4. Distribution panelboards.
5. Disconnect switches.
6. Control panels.

3.5 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.6 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

END OF SECTION 260574

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Digital timer light switches.
6. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Faulty operation of lighting control software.
b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. Contact Configuration: DPDT.
3. Contact Rating: 20-A ballast load, 120-/240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Programs: 2 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
7. Astronomic Time: All channels.
8. Automatic daylight savings time changeover.
9. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. Tyco Electronics Corporation; a TE Connectivity Ltd. company.

B. Description: Solid state, with SPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc , with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

2.3 INDOOR OCCUPANCYAND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. Lutron Electronics Co., Inc.
6. Philips Lighting Controls.
7. Watt Stopper.

B. General Requirements for Sensors:

1. Wall, Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared, Ultrasonic, Dual technology.
3. Separate power pack.
4. Hardwired, Wireless connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A, Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.
b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc ; turn lights off when selected lighting level is present.

C. PIR Type: Wall, Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. .
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.

D. Ultrasonic Type: Wall, Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 84 inches above finished floor.

E. Dual-Technology Type: Wall, Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. , and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lithonia Lighting; Acuity Brands Lighting, Inc.
5. Lutron Electronics Co., Inc.
6. Philips Lighting Controls.
7. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, using hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

2.5 DIGITAL TIMER LIGHT SWITCH

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.

1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for LED, and 1/4 horsepower at 120-V ac.
2. Integral relay for connection to BAS.
3. Voltage: Match the circuit voltage, or Dual voltage - 120 and 277 V.
4. Color: White.
5. Faceplate: Color matched to switch.

2.6 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a business of Emerson Network Power.
3. Eaton Corporation.
4. General Electric Company.
5. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch .

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.8 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

END OF SECTION 260923

SECTION 260943 - RELAY-BASED LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Lighting control relay panels.
2. Manual switches and cover plates.
3. Field-mounted signal sources.
4. Conductors and cables.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. Monitoring: Acquisition, processing, communication, and display of equipment status data, event and alarm signals, tabulated reports, and event logs.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, relays, manual switches and cover plates, and conductors and cables.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Operational documentation for software and firmware.

B. Shop Drawings: For each relay panel and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than Type 1.
3. Detail wiring partition configuration, current, and voltage ratings.

4. Short-circuit current rating of relays.
5. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
6. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
7. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panels for installation in accordance with NECA 407.

1.7 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that components of standalone multipreset modular controls perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: Two year(s) from date of Substantial Completion, for labor, materials, and equipment.
2. Follow-on Extended Warranty Period: Eight year(s) from date of Substantial Completion, for materials that failed because of transient voltage surges only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Sequence of Operations: Input signal from field-mounted manual switches, or digital signal sources, must open or close one or more lighting control relays in the lighting control panels. Any combination of inputs must be programmable to any number of control relays.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.

D. Comply with UL 916.

2.2 LIGHTING CONTROL RELAY PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Industries, Inc. – LiteKeeper LK8
2. Hubbell Control Solutions
3. Acuity Brands
4. Leviton Manufacturing Co., Inc.
5. Douglas Lighting Control.

B. Description: Standalone lighting control panel using mechanically latched relays to control lighting and appliances.

C. Lighting Control Panel:

1. A single enclosure with incoming lighting branch circuits, control circuits, switching relays, and on-board timing and control unit.
2. A vertical barrier separating branch circuits from control wiring.

D. Control Unit: Contain the power supply and electronic control for operating and monitoring individual relays.

1. Timing Unit:

a. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
b. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
c. 64 Time-Of-Day/holiday schedules for 365 day programming.
d. Schedule periods settable to the minute.
e. Day-of-week, day-of-month, day-of-year with one-time or repeating capability.
f. 32 special date periods.

2. Sequencing Control with Override:

a. Automatic sequenced on and off switching of selected relays at times set at the timing unit, allowing timed overrides from external switches.
b. Sequencing control must operate relays one at a time, completing the operation of all connected relays in not more than 10 seconds.
c. Override control must allow any relay connected to it to be switched on or off by a field-deployed manual switch or by an automatic switch, such as an occupancy sensor.
d. Override control "blink warning" must warn occupants approximately five minutes before actuating the off sequence.

3. Nonvolatile memory must retain all setup configurations. After a power failure, the controller must automatically reboot and return to normal system operation, including accurate time of day and date.

E. Relays:

1. Electrically operated, electrically or mechanically held single-pole switch, rated at 20 A at 277 V. Short-circuit current rating must be not less than 10 kA. Control must be three-wire, 24 V(ac).

F. Power Supply: NFPA 70, Class 2, sized for connected equipment, plus 20 percent spare capacity. Powered from a dedicated branch circuit of the panelboard that supplies power to the line side of the relays, sized to provide control power for the local panel-mounted relays, bus system, control-voltage inputs, field-installed occupancy sensors, and photo sensors.

G. Operator Interface:

1. Integral alphanumeric keypad and digital display, and intuitive drop-down menus to assist in programming.
2. Log and display relay on-time.
3. Connect relays to one or more time and sequencing schemes.

2.3 FIELD-MOUNTED SIGNAL SOURCES

A. Indoor Occupancy Sensors: Comply with Section 260923 "Lighting Control Devices." Control power may be taken from the lighting control panel, and signal must be compatible with the relays.

2.4 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cables: Multiconductor cable with copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 16 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Twisted-Pair Data Cable: Category 5e.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panels in accordance with NECA 407.

B. Examine panels before installation. Reject panels that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panels for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING

A. Wiring Methods:

1. Install conductors and cables concealed in accessible ceilings, walls, and floors where possible.
2. Conceal raceway and cables except in unfinished spaces.
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 INSTALLATION OF PANELS

A. Install panels and accessories in accordance with NECA 407.

B. Mount panel cabinet plumb and rigid without distortion of box.

C. Install filler plates in unused spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

C. Create a directory to indicate loads served by each relay; incorporate Owner's final room designations. Obtain approval before installing. Use a PC or typewriter to create directory; handwritten directories are unacceptable.

D. Lighting Control Panel Nameplates: Label each panel with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operational Test: After installing lighting control relay panel and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:

1. Lighting control panel will be considered defective if it does not pass tests and inspections.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Prepare test and inspection reports, including a certified report that identifies lighting control panels and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

D. Manufacturer Services:

1. Engage factory-authorized service representative to support field tests and inspections.

3.6 SYSTEM STARTUP

A. Perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's instructions.
2. Confirm correct communications wiring, initiate communications between panels, and program the lighting control system in accordance with approved configuration schedules, time-of-day schedules, and input override assignments.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 MAINTENANCE

A. Software and Firmware Service Agreement:

1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for two years.
2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.

    a. Upgrade Notice: No fewer than 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260943

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Distribution, dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, conduit entrance and available space, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

C. Certified Test Results: Provide for each transformer 500 kVA and above, indicating:

1. Core loss.
2. Coil Loss.
3. Magnetizing Current.
4. Sound Level.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For transformers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control reports.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Electric Corporation.
2. Controlled Power Company; an Emerson company.
3. Eaton.
4. General Electric Company.
5. Hammond Power Solutions Inc.
6. Powersmiths International Corp.
7. Siemens Power Transmission & Distribution, Inc.
8. Sola/Hevi-Duty; a brand of Emerson Electric Co.
9. Square D; by Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service. Fan-cooled units shall not be used.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger: Comply with DOE Code of Federal Regulation 10 CFR 431, as amended by final ruling 78 FR 23335.

D. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

E. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

F. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

G. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

H. Nameplate: Metallic, secured to outside front of enclosure with pins, screws, or permanent adhesive and embossed with all pertinent information such as connection diagrams, temperature ratings, electrical ratings, sound levels, impedances, weight, etc.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, drip-proof, unless otherwise indicated.

1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air, and secured with rubber mounts.
2. Maximum enclosure temperature shall be 50 degree C rise above 40 degree C ambient.
3. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.

D. Enclosure for Outdoor Transformers: Totally enclosed, nonventilated.

1. NEMA 250, Type 3R Type 4X, Stainless Steel: Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

F. Taps for Transformers 3 kVA and Smaller: None.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

I. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature, unless otherwise indicated.

J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 150 115 80-deg C rise above 40-deg C ambient temperature, unless otherwise indicated.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.
3. Provide secondary neutral terminal sized at 200 percent of rated secondary current.
4. Provide electrostatic shielding as described below.

L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize inter-winding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:

a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

M. Neutral: Rated 200 percent of full load current for K-factor rated transformers.

N. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION DEVICES

A. Labels: Engraved, laminated-plastic label for each distribution transformer, mounted with permanent adhesive. Identification and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:

    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.

9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems." Connect secondary neutral and grounding to separately derived ground system .

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Flexible raceways for incoming and outgoing wiring according to Section 260533 - Raceways and Boxes for Electrical Systems".

D. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

E. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Verify nameplate data matches drawing and specification requirements.
2. Inspect physical and mechanical condition of equipment.
3. Confirm shipping brackets have been removed and isolation mounts are functioning correctly.
4. Verify all bolted connections meet manufacturer's recommended tightness.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

B. Touch up scratched and marred surfaces to match original finish.

END OF SECTION 262200

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

B. Related Requirements

1. Section 260574 "Overcurrent Protective Device Arc-Flash Study" for arc-flash analysis and arc-flash label requirements.
2. Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits".

1.3 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Submit simultaneously with or after the Overcurrent Protective Device Short-Circuit, Coordination, and Arc-Flash Studies.
2. Include dimensioned plans, elevations, sections, and details, including pad dimensions, required clearances and service space around equipment, and connections. Show tabulations of installed devices, equipment features, and ratings.
3. Detail enclosure types for types other than NEMA 250, Type 1.
4. Detail bus configuration, current, and voltage ratings.
5. Detail short-circuit current rating of switchboards and overcurrent protective devices.

6. Nameplate nomenclature and indication of service entrance label.
7. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
8. Detail utility company's metering provisions with written approval from utility company indicating acceptance.
9. Include evidence of NRTL listing for series rating of installed devices.
10. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
11. Include schematic and wiring diagrams for power, signal, and control wiring.
12. Manufacturer's recommendations for storage and protection, field test requirements, and tightening of bus connections.

C. Delegated Design Submittal:

1. For arc-flash hazard analysis.
2. For arc-flash labels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Routine maintenance requirements for switchboards and all installed components.
b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, corrosive substances, and physical damage.

C. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage.

D. If stored in areas subjected to weather, cover switchboards to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

E. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.9 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Nominal System Voltage: As shown on Drawings.

J. Main-Bus Continuous: As shown on Drawings.

K. Bus Bracing: 100,000 amperes RMS symmetrical[, unless a greater capacity is required by Overcurrent Protective Device Short-Circuit Study.

L. Duty Rating: Assembly fully rated for 100 percent operation at 100 percent duty where main or branch circuit devices are so rated.

M. Short Circuit Rating: Fully rated as shown on Drawings, or as required by Overcurrent Protective Device Short-Circuit Study, to interrupt symmetrical short-circuit current available at terminals. Series-connected ratings are NOT allowed.

N. Indoor Enclosures: Steel, NEMA 250, Type 1.

O. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

P. Barriers: Between adjacent switchboard sections.

Q. Insulation and isolation for main and vertical buses of feeder sections.

R. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

S. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

T. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

U. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

V. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.

2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
4. Copper feeder circuit-breaker line connections.
5. Tin-plated aluminum feeder circuit-breaker line connections.
6. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
7. Ground Bus: 1/4-by-2-inch- minimum-size or larger as required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
8. Main-Phase Buses, Neutral Buses, and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
9. Line and Load Terminals: Suitable for size, number, material and operating temperature of conductors, i.e., 75 degrees C or 90 degrees C as applicable.
10. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.

11. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
12. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

W. Future Devices: Make provisions for future devices to full height of each section whether section contains devices or not. Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.3 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Protection Technologies Inc. (APT).
2. Eaton.
3. General Electric Company.
4. Liebert.
5. SIEMENS Industry, Inc.; Energy Management Division.
6. Square D; by Schneider Electric.

B. SPDs: Comply with UL 1449, Type 1 Type 2.

C. Features and Accessories:

1. Integral disconnect switch.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Indicator light display for protection status.
4. Form-C contacts rated at 5 A and 250-V ac 2 A and 24-V ac Insert values, one normally open and one normally closed, for remote monitoring of protection status.
5. Surge counter.
6. Install SPD units within this equipment in accordance with SPD manufacturer's requirements.
7. Locate SPD in same section as incoming lugs and connect as close as possible to incoming lugs.
8. Provide individual, appropriately sized, branch protective device for each SPD. Cable to SPD shall be as short as possible and free from sharp bends.
9. Locate SPD units within equipment such that SPD monitoring devices are clearly visible from front without having to remove doors or panels.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 200 kA.

G. Inominal Rating: 20 kA.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Common simultaneous-trip for 2 and 3 pole breakers. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Circuit breakers having 400A or higher trips shall have electronic trip unit.
4. Electronic trip circuit breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or field-replicable electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.

d. Multi-button keypad to access programmable functions and monitored data.
e. Ten event, trip history log. Each event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-adjustable settings:

1) Standard, High-range instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time delay adjustments.
4) Ground-fault pickup level, time delay, and I squared t response.

5. Circuit breakers having 1000 amp or higher trip shall be UL listed/labeled for operation at 100 percent of amp rating.
6. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
7. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
8. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles. Individually insulated, braced and protected connectors.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
c. Application Listing: Appropriate for application; Type SWD for switching lighting loads; Type HACR for heating, air conditioning, and refrigerating equipment.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function and prohibiting upstream devices from tripping on ground-fault when downstream device senses and trips from ground-fault.
f. Communication Capability: Universal-mounted Integral communication module with functions and features compatible with power monitoring and control system.
g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
i. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed Drawout circuit-breaker mounting.
2. Manually operated through two-step, stored-energy closing, with indication of charged and discharged positions, open and closed control pushbuttons, and indication of open and closed positions.
3. Standard Full-function, microprocessor-based trip units with interchangeable rating plug, LED trip indicators for short-circuit and overload conditions, and the following field-adjustable settings:

    a. Standard, High-range instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time delay adjustments with I squared t response.
    d. Ground-fault pickup level, time delay, and I squared t response.

4. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
5. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function and prohibiting upstream devices from tripping on ground-fault when downstream device senses and trips from ground-fault.
6. Remote trip indication and control.
7. Communication Capability: Web enabled integral Ethernet communication module and embedded Web server with factory-configured Web pages (HTML file format). Provide functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Control Voltage: 40-V dc 125-V dc 250-V dc 120-V ac.

C. Bolted-Pressure Contact Switch: Fully rated, operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts, with interrupting capacity rating of 200,000 RMS symmetrical amperes (with fuses), and provisions for Class L current limiting fuses.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Boltswitch, Inc.
    b. Eaton.
    c. SIEMENS Industry, Inc.; Energy Management Division.
    d. Square D.

2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.

a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.

4. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
5. Service-Rated Switches: Labeled for use as service equipment.
6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, pilot light to indicate presence of control voltage, reset function, test function, tripping relay with internal memory, and three-phase current transformer/sensor. Calibrate at factory and coordinate trip characteristics to not clear faults normally cleared by main switch.

   a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
   c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
   d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
   e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function and prohibiting upstream devices from tripping on ground fault when downstream device senses and trips from ground fault.

7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

2.5 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, and the following:

1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, single tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; wound bushing bar or window type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit providing true RMS metering, suitable for three- or four-wire systems, ANSI C12.16 revenue accuracy, and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

    a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    d. Megawatts: Plus or minus 1 percent.
    e. Megavars: Plus or minus 1 percent.
    f. Power Factor: Plus or minus 1 percent.
    g. Frequency: Plus or minus 0.1 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
    j. Power quality.
    k. Harmonic Analysis.
    l. Trim and/or alarm outputs for phase loss (voltage or current), phase unbalance, phase reversal, over-voltage and under-voltage.
    m. Standard pulse output (KYZ).
    n. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.
3. RS-485 and RS-232 communications.

C. Analog Meters:

1. Meters: 4-inch diameter or 6 inches square, flush or semiflush, with anti-parallax 250-degree scales and external zero adjustment.

D. Voltmeters: Cover an expanded-scale range of nominal voltage plus 10 percent.

E. Instrument Switches: Rotary type with off position.

1. Voltmeter Switches: Permit reading of all phase-to-phase voltages and, where a neutral is indicated, phase-to-neutral voltages.
2. Ammeter Switches: Permit reading of current in each phase and maintain current-transformer secondaries in a closed-circuit condition at all times.

F. Ammeters: 2-1/2-inch minimum size with 90- or 120-degree scale. Meter and transfer device with off position, located on overcurrent device door for indicated feeder circuits only.

G. Watt-Hour Meters and Wattmeters:

1. Comply with ANSI C12.1.

2. Three-phase induction type with two stators, each with current and potential coil, rated 5 A, 120 V, 60 Hz.
3. Suitable for connection to three- and four-wire circuits.
4. Potential indicating lamps.
5. Adjustments for light and full load, phase balance, and power factor.
6. Four-dial clock register.
7. Integral demand indicator.
8. Contact devices to operate remote impulse-totalizing demand meter.
9. Ratchets to prevent reverse rotation.
10. Removable meter with drawout test plug.
11. Semiflush mounted case with matching cover.
12. Appropriate multiplier tag.

H. Impulse-Totalizing Demand Meter:

1. Comply with ANSI C12.1.
2. Suitable for use with switchboard watt-hour meter, including two-circuit totalizing relay.
3. Cyclometer.
4. Four-dial, totalizing kilowatt-hour register.
5. Positive chart drive mechanism.
6. Capillary pen holding a minimum of one month's ink supply.
7. Roll chart with minimum 31-day capacity; appropriate multiplier tag.
8. Capable of indicating and recording five 15-minute integrated demand of totalized system.

2.6 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Furnish standard lifting eyes, yokes and skids.

B. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

C. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

D. Portable Circuit-Breaker Lifting Device: Floor-supported, roller-based, elevating carriage arranged for movement of circuit breakers in and out of compartments for present and future circuit breakers.

E. Mounting Accessories: For anchors, mounting channels, bolts, washers, and other mounting accessories, comply with requirements in manufacturer's instructions.

2.8 IDENTIFICATION

A. Provide each overcurrent protective device with label identifying load served and location of load; comply with Section 260553 "Identification for Electrical Systems".

B. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine clearances, elements and surfaces to receive switchboards for compliance with move into facility and with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Comply with NECA 1.

H. Ground switchboards per NFPA 70 and Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 CONNECTIONS

A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

B. Support and secure conductors within the switchboard according to NFPA 70.

C. Tighten bus connections and mechanical fasteners in accordance with manufacturer's published torque value recommendations and UL 486A and B.

3.4 IDENTIFICATION

A. Conductors: Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label switchboard and each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Verify nameplate data, overcurrent protective device sizes and types, and current and voltage transformer ratios match drawing and specification requirements.
2. Inspect physical and mechanical condition of equipment.
3. Verify required anchoring of equipment to floor and wall.
4. Verify all bolted connections meet manufacturer's recommended tightness.
5. Acceptance Testing:

    a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    b. Test continuity of each circuit.

6. Test ground-fault protection of equipment for service equipment per NFPA 70.
7. Verify operation of electrical and mechanical interlocks.
8. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
9. Perform the following infrared scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

10. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Submit simultaneously with or after the Overcurrent Protective Device Short-Circuit, Coordination, and Arc-Flash Studies.
2. Include dimensioned plans, elevations, sections, and details.

3. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
4. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
5. Detail bus configuration, current, and voltage ratings.
6. Short-circuit current rating of panelboards and overcurrent protective devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, maintenance manuals, and the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard, unless otherwise noted.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.9 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

D. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush or Surface-mounted, as shown on Drawings, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.

F. Phase, Neutral, and Ground Buses:

1. Material and Type: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.
    c. Sequence type bussing interval connections, bus structure and main lugs or main protective devices with current ratings shown on Drawings.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Standard Neutral: Full capacity, equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Split Bus: Vertical buses divided into individual vertical sections.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated bus ampacity and conductor sizes shown on Drawings, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices. Provide blank covers for all unused device spaces.

1. Percentage of Future Space Capacity: Ten 20 percent, unless indicated otherwise.

J. Panelboard Short-Circuit Current Rating: Fully rated as shown on Drawings, or as required by Overcurrent Protective Device Short-Circuit Study, to interrupt symmetrical short-circuit current available at terminals. Series-connected ratings are NOT allowed. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

K. Circuit Breakers: Provide all circuit breakers on project from one manufacturer unless not commercially available.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1, Type 2.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. ESL Power Systems, Inc.
3. General Electric Company; GE Energy Management - Electrical Distribution.
4. SIEMENS Industry, Inc.; Energy Management Division.
5. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, distribution type.

C. Mains: Circuit breaker or lugs only, as shown on Drawings.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

E. Circuit breaker panelboards equal to I-Line type, manufactured by Square D Company.

F. Minimum Box Size: 26 inches (655 mm) wide, 6-1/2 inches (165 mm) deep, 600 amp and below; 42 inches (1060 mm) wide, 9-1/2 inches (240 mm) deep above 600 amps.

G. Provide load identification at each device per Section 260553 - "Identification for Electrical Systems."

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only, as shown on Drawings.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike. Provide two (2) keys with each panelboard.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; all panelboards keyed alike. Provide two (2) keys with each panelboard. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

G. Short circuit current ratings as shown on Drawings, but not less than 10,000 RMS symmetrical amperes for panelboards rated 240 V or less, and 14,000 RMS symmetrical amperes for panelboards rated above 240 V and less than or equal to 600 V.

H. Equal to NQ and NF type manufactured by Square D Company.

I. Standard Box Size: 5-3/4 inches (145 mm) deep, 20 inches (500 mm) wide.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company; GE Energy Management - Electrical Distribution.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents or as shown on Drawings, whichever is higher.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Common simultaneous trip for 2 and 3 pole breakers.
    d. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Circuit breakers having 400A or higher trips shall have electronic trip unit.
4. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or field-replicable electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.

e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Standard, High-range instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time delay adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

5. Circuit breakers having 1000 amp or higher trip shall be UL listed/labeled for operation at 100 percent of amp rating.
6. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
7. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
8. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
9. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
10. Subfeed Circuit Breakers: Vertically mounted.
11. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Individually insulated, braced and protected connectors.
c. Breaker handle indicates tripped status.
d. UL listed for reverse connection without restrictive line or load ratings.
e. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
f. Application Listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment.
g. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
h. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system.
i. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
j. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
k. Rating Plugs: Three-pole breakers with ampere ratings greater than 400 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
l. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
m. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
n. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

o. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices, prohibiting upstream devices from tripping when downstream device senses and trips from ground fault.
p. Multipole units enclosed in a single housing with a single handle orfactory assembled to operate as a single unit.
q. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
r. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD, horsepower rated, quick-make, quick-break; clips for Class R rejection fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
2. Fused Switch Features and Accessories:

a. Standard ampere ratings and number of poles.
b. Short circuit current rating of 200,000 RMS symmetrical amperes (with fuses).
c. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
d. Auxiliary Contacts: One normally open and normally closed contact(s) that operate with switch handle operation.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder or metal frame with transparent protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards 60 inches or greater in height on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
2. Install panelboards less than 60 inches in height on wall.
3. Attach panelboard to the vertical finished or structural surface behind the panelboard.
4. Provide steel channel supports to bridge studs above and below panelboards in stud partitions.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount panelboards such that top of switch or breaker handle is located 6'-6" or less above finished floor unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards in wet or damp locations, such as concrete basement walls, to steel slotted supports 1 1/4 inch in depth. Orient steel slotted supports vertically.

J. Mechanically bolt panelboards of more than one (1) section together.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Provide breaker locking devices as required by other sections of Division 26.

3.3 IDENTIFICATION

A. Conductors: Identify field-installed conductors, interconnecting wiring, and components; complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Branch-Circuit Panelboard Directories: Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations and equipment being served. Use identifications compatible with Owner's program and readily identifiable without removing directory from its holder. Obtain Owner's approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
2. Verify nameplate data and overcurrent protective device sizes and types match drawing and specification requirements.
3. Inspect physical and mechanical condition of equipment.
4. Verify required anchoring of equipment to floor and wall.
5. Verify all bolted connections meet manufacturer's recommended tightness.
6. Test ground-fault protection of equipment per NFPA 70.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.
5. Re-label affected equipment, devices, junction boxes, wiring, panelboard directories, etc. due to load reconnection and branch circuit number changes.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain panelboards, overcurrent protective devices, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. SPD receptacles, 125 V, 20 A.
5. Twist-locking receptacles.
6. Pendant cord-connector devices.
7. Toggle switches, 120/277 V, 20 A.
8. Occupancy sensors.
9. Digital timer light switches.
10. Wall-box dimmers.
11. Wall plates.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory White unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.
3. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain all wiring devices and associated wall plates on project from same manufacturer unless not commercially available.

2.2 STANDARD RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.

5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Two pole, three wire, and self-grounding, back and side wired. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 USB RECEPTACLES

A. Tamper-Resistant Duplex and USB Charging Duplex Receptacles :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Revisions to UL 943, effective June 29, 2015, require GFCI receptacles to have an auto-monitoring or self-test function, denying power or providing visual and/or audible indication, and to have a repeatable reverse line-load mis-wire function, denying power to the receptacle at the initial installation and any subsequent re-installations.End of life provision, denying power to receptacle face, or indicating with visual or audible means that device must be replaced, when receptacle can no longer provide ground fault protection (as indicated by the inability to pass its internal self-test function).
7. Reverse line-load mis-wire, denying power to receptacle face if device is mis-wired, at initial installation or re-installations.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Hubbell Incorporated; Wiring Device-Kellems.
    b. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. End of life provision, denying power to receptacle face, or indicating with visual or audible means that device must be replaced, when receptacle can no longer provide ground fault protection (as indicated by the inability to pass its internal self-test function).
7. Reverse line-load mis-wire, denying power to receptacle face if device is mis-wired, at initial installation or re-installations.
8. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. End of life provision, denying power to receptacle face, or indicating with visual or audible means that device must be replaced, when receptacle can no longer provide ground fault protection (as indicated by the inability to pass its internal self-test function).
7. Reverse line-load mis-wire, denying power to receptacle face if device is mis-wired, at initial installation or re-installations.
8. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Back and side wired.

3. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Back and side wired.

3. Standards: Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Comply with UL 20 and FS W-S-896.

D. Four-Way Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Back and side wired.
3. Standards: Comply with UL 20 and FS W-S-896.

E. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Illuminated when switch is on.
3. Standards: Comply with UL 20 and FS W-S-896.

F. Lighted Single-Pole Switches, 120/277 V, 20 A :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Premise Wiring.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Handle illuminated when switch is off.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

G. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Factory-supplied key in lieu of switch handle.
3. Standards: Comply with UL 20 and FS W-S-896.

H. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: For use with mechanically held lighting contactors.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

I. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.6 OCCUPANCY AND VACANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.

d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Adjustable off time delay of up to 20 minutes.
6. Able to be locked to Automatic Manual-On mode.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
8. Connections: Provisions for connection to BAS.
9. Connections: RJ-45 communications outlet.
10. Connections: Integral wireless networking.

B. Wall Sensor Light Switch, Passive Infrared:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Industries.
b. Hubbell Premise Wiring.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
3. Standards: Comply with UL 20.
4. Connections: Provisions for connection to BAS.
5. Connections: Hard wired.
6. Connections: Wireless.
7. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
8. Integral relay for connection to BAS.
9. Adjustable time delay of five 10 15 20 minutes.
10. Able to be locked to Automatic Manual-On mode.
11. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

C. Wall Sensor Light Switch, Ultrasonic:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.

2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using ultrasonic technology.
3. Standards: Comply with UL 20.
4. Connections: Provisions for connection to BAS.

5. Connections: RJ-45 communications outlet.
6. Connections: Integral wireless networking.
7. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
8. Integral relay for connection to BAS.
9. Adjustable time delay of five 10 15 20 minutes.
10. Able to be locked to Automatic Manual-On mode.
11. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.7 TIMER LIGHT SWITCH

A. Digital Timer Light Switch:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.

2. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10 20-minute increments.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Integral relay for connection to BAS.

2.8 DIMMERS

A. Wall-Box Dimmers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton (Arrow Hart).
    b. Hubbell Incorporated; Wiring Device-Kellems.
    c. Leviton Manufacturing Co., Inc.
    d. Lutron Electronics Co., Inc.
    e. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
3. Control: Continuously adjustable slider; with single-pole or three-way switching.
4. Standards: Comply with UL 1472.
5. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

    a. 600 W; dimmers shall require no derating when ganged with other devices.

6. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.9 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices. Wall plates of same material shall match same finish and details. Where two-gang boxes are required for single-gang devices, provide special wall plates with device opening in one gang and second gang blank.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces and Flush Boxes in Unfinished Spaces: 0.10-inch thick, smooth, high-impact thermoplastic 0.035-inch- thick, satin-finished, Type 302 stainless steel, beveled type, with smooth rolled outer edge.
3. Material for Surface Boxes in Unfinished Spaces: Type 302 stainless steel.
4. Material for Damp Locations: Thermoplastic Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: Gasketed NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum thermoplastic with lockable cover. Provide spring-loaded gasketed doors for receptacles.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, except use mounting heights shown on Drawings, where indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. Use a torque screwdriver when a torque is recommended or required by manufacturer.
6. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
7. Tighten unused terminal screws on the device.
8. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
9. Mount switches vertically, plumb with building lines, and approximately 6 inches (151 mm) from door opening.
10. Mount receptacles vertically, unless otherwise noted on drawings, and at heights shown on drawings.
11. Secure switches and receptacles firmly to backbox, not to wall and/or coverplate, with device extending through coverplate on all sides.
12. Coordinate device mounting locations with architectural details.
13. Mount receptacles occupying same wall space as fintube radiation horizontally in toespace at 4 inches (105 mm) to top. Do not mount above fintube.
14. Install switches controlling 277 volt circuits in individual outlet boxes or in gang boxes with approved barriers between switches.
15. Provide G.F.C.I. outlet at each location shown on drawings. Do not use one G.F.C.I. outlet to protect downstream outlets.
16. Do not use common neutrals on dimmer circuits.
17. Install cover plates on all outlet boxes. Match plate configuration to devices within box.
18. Mount flush plates so all four (4) edges are in continuous contact with finished wall.
19. Install blank cover plates on all open outlet boxes.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left (neutral contact at top).

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Follow dimmer manufacturer's directions when ganging dimmers.
3. Verify that dimmers used for fan-speed control are listed for that application.
4. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black -filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Test straight-blade convenience outlets in patient-care areas hospital-grade outletsfor the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz..

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

    a. Control circuits.
    b. Panelboards.
    c. Switchboards.
    d. Enclosed controllers.
    e. Enclosed switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Edison; a brand of Bussmann by Eaton.
3. Littelfuse, Inc.
4. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
3. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance, 601 to 6000 Amperes: Class L, time delay, 200,000 amperes RMS symmetrical interrupting rating.
2. Service Entrance, 1/10 to 600 Amperes: RK1, time delay, 300,000 amperes RMS symmetrical interrupting rating.
3. Feeders, 601 to 6000 Amperes: Class L, time delay, 300,000 amperes RMS symmetrical interrupting rating.
4. Feeders, 1/10 to 600 Amperes: Class RK1, time delay, 300,000 amperes RMS symmetrical interrupting rating.
5. Motor Branch Circuits, 1/10 to 600 Amperes: Class RK1, time delay, 300,000 amperes RMS symmetrical rating.
6. Large Motor Branch Circuits, 601 to 4000 Amperes: Class L, time delay, 300,000 amperes RMS symmetrical interrupting rating.
7. Other Branch Circuits: Class RK1, time delay.
8. Control Transformer Circuits: Class CC, time delay, control transformer duty.

3.3 INSTALLATION

A. Install fuses in each fusible device, including those furnished by others, after equipment is set in place. Arrange fuses so rating information is readable without removing fuse.

B. Replace all fuses that have opened during construction.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information (class, size, etc.) inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Non-fusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

B. Section also includes switches and circuit breakers added to existing distribution equipment and mounted therein.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Submit simultaneously with or after the Overcurrent Protective Device Short-Circuit, Coordination, and Arc-Flash Studies.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device Provide in PDF and electronic format.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7**.**

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

E. Minimum interrupting capacity equal to upstream device, or as required by Overcurrent Protective Device Short-Circuit Study. Series rated equipment is NOT allowed.

F. Minimum interrupting capacity equal to that of existing equipment, for switches and circuit breakers added to existing distribution equipment.

2.3 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Inc.
2. Eaton.
3. General Electric Company.
4. SIEMENS Industry, Inc.; Energy Management Division.

5. Square D; by Schneider Electric.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with Class R rejection fuse clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: One Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24-V ac 120-V ac 208-V ac 240-V ac 6-V dc 12-V dc 24-V dc.
5. Lugs: Mechanical Compression type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment when used as main disconnecting means.

2.4 NON-FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 240 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Auxiliary Contact Kit: One Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 24-V ac 120-V ac 208-V ac 240-V ac 6-V dc 12-V dc 24-V dc.
4. Lugs: Mechanical Compression type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment when used as main disconnecting means.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker..

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 167 deg F rated wire 194 deg F rated wire, sized according to the 167 deg F temperature rating in NFPA 70.

G. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Common simultaneqous trip for 2 and 3-pole breakers.

I. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

J. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip) for personnel protection.

K. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip) for equipment protection.

L. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles. Individually insulated, braced and protected connectors.
2. Lugs: Mechanical Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching lighting loads; Type HACR for heating, air conditioning, and refrigerating equipment.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Communication Capability: Circuit-breaker-mounted Universal-mounted Integral Din-rail-mounted communication module with functions and features compatible with power monitoring and control system, specified in Section 260913 "Electrical Power Monitoring and Control."
6. Shunt Trip: 120-V trip coil energized from separate circuit, with coil-clearing contact.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
8. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking two or more levels of ground-fault protection and prohibiting upstream devices from tripping on ground fault when downstream device senses and trips from ground fault.
11. Electrical Operator: Provide remote control for on, off, and reset operations.
12. Accessory Control Power Voltage: Integrally mounted, self-powered Remote mounted and powered; 24-V ac 120-V ac 208-V ac 240-V ac 12-V dc 24-V dc 120-V dc.
13. Service-Rated Circuit Breakers: Labeled for use as service equipment when used as main disconnecting means.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel) copper-free cast aluminum alloy (NEMA 250 Types 7, 9).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R), externally operable with the operating mechanism being an integral part of the cover (NEMA 250 Types 7, 9). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

G. Surface or recessed mounting as shown on Drawings.

H. Provisions for padlocking device in OFF position, and in ON and OFF positions for outdoor locations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R Type 4X.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Anchor floor-mounting switches and circuit breakers to concrete base. Provide mounting brackets, wall bracing and accessories as required.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

F. Set field-adjustable switches and circuit-breaker trip ranges.

G. Paint enclosure trims of recessed circuit breakers to match adjacent wall color.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.
3. Install typed label indicating fuse replacement information (class, size, etc.) on inside of door of each fusible switch or controller.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

    1) Use a low-resistance ohmmeter.

        a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

    2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

        a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
    c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
g. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
h. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

1. Test procedures used.
2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Overcurrent Protective Device Coordination Study."

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of enclosed switches and circuit breakers. Remove paint splatters and other spots. Vacuum dirt and debris. Do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed switches and circuit breakers, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller.

1. Submit simultaneously with or after the Overcurrent Protective Device Short-Circuit, Coordination, and Arc-Flash Studies.
2. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.
3. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

4. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

C. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.10 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 GENERAL CONTROLLER REQUIREMENTS

A. Minimum interrupting capacity equal to upstream device or as required by Overcurrent Protective Device Short-Circuit Study. Series rated equipment is NOT allowed.

B. Minimum interrupting capacity equal to that of existing equipment, for controllers replacing existing equipment.

2.2 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A, sized for motor horsepower.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing, unless noted otherwise.
3. Flush mounting, unless noted otherwise.
4. Red pilot light (two for two-speed motors).

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle, or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing, unless noted otherwise.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; ambient temperature-compensated bimetallic type.
4. Flush mounting, unless noted otherwise.
5. Red pilot light (two for two-speed motors).

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.

2. Configuration: Nonreversing, unless noted otherwise.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; ambient temperature-compensated, bimetallic type.
4. Flush mounting, unless noted otherwise.
5. Red pilot light (two for two-speed motors).
6. N.O. N.C. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    c. Rockwell Automation, Inc.; Allen-Bradley brand.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.

2. Annunciation and Controls: Run red transformer-type pilot light in cover (two for two-speed motors). Reset button and hand-off-auto switch in cover field convertible to off/auto or start/stop pushbutton, unless other devices are shown. Verify control switch requirements from Drawings.
3. Configuration: Nonreversing, unless otherwise noted.
4. Contactor Coils: Pressure-encapsulated type.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

5. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
6. Control Circuits: 120 -V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 percent.

7. Auxiliary Contacts: One set of spare normally open and normally closed contacts in addition to standard auxiliary holding contacts supplied with each starter, arranged to activate before switch blades open.
8. Bimetallic Overload Relays:

    a. Inverse-time-current characteristic.
    b. Class 10 tripping characteristic.
    c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    d. Ambient compensated.
    e. Automatic resetting.

9. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means. Refer to requirements for magnetic controller as described above. Provide operating handle with lock-off facility. Refer to drawings for switch requirements, i.e., fusible, non-fusible or automatic motor circuit protector type. Restrict opening of switch enclosure by the use of defeater screw unless switch is in OFF position. Provisions for padlocking indoor starters in “OFF” position and outdoor starters in “OFF" and “ON" positions.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
    b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
    c. Rockwell Automation, Inc.; Allen-Bradley brand.
    d. Siemens Energy & Automation, Inc.
    e. Square D; a brand of Schneider Electric.

2. Fusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with Class R rejection-type clips or bolt pads to accommodate Class R fuses.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

3. Auxiliary Contacts: One set of spare normally open and normally closed contacts in addition to standard auxiliary holding contacts supplied with each starter, arranged to activate before switch blades open.

4. Nonfusible Disconnecting Means:

    a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary Contacts: One set of spare normally open and normally closed contacts in addition to standard auxiliary holding contacts supplied with each starter, arranged to activate before switch blades open.

5. MCP Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity of 42,000 AIC for 480 volt, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.
    d. N.C. N.O. alarm contact that operates only when MCP has tripped.
    e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

6. MCCB Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity of 42,000 AIC for 480 volt; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
    b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
    e. N.C. N.O. alarm contact that operates only when MCCB has tripped.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R or Type 4X.
3. Other Wet or Damp Indoor Locations: Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.4 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy -duty, type.

    a. Push Buttons: Unguarded types; maintained or momentary as indicated.
    b. Pilot Lights: LED types; colors as indicated; push to test.
    c. Selector Switches: Rotary type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch enclosed controller.

D. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

E. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Install typed label indicating fuse and overload protection replacement information (class, size, etc.) inside door of each controller.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

7. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports including a certified report that identifies enclosed controllers. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262913

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 262413 "Switchboards" for factory-installed SPDs.
2. Section 262416 "Panelboards" for factory-installed SPDs.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

I. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

J. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB France.
2. Advanced Protection Technologies Inc. (APT).
3. Eaton Corporation.
4. Emerson Electric Co.
5. GE Zenith Controls.
6. LEA International; Protection Technology Group.
7. Leviton Manufacturing Co., Inc.
8. PowerLogics, Inc.
9. Schneider Electric Industries SAS.
10. Siemens Industry, Inc.

2.2 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be at least 125 percent of the nominal system voltage.

2.3 SERVICE ENTRANCE SUPPRESSOR

A. SPDs: Comply with UL 1449, Type 1, Type 2.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1, Type 2

1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.
d. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 200 kA.

G. Inominal Rating: 20 kA.

2.4 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 1, Type 2.

1. Include LED indicator lights for power and protection status.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Comply with UL 1283.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 700 V for 208Y/120 V.
3. Neutral to Ground: 700 V for 208Y/120 V.
4. Line to Line: 1200 V for 208Y/120 V

E. SCCR: Equal or exceed 100 kA.

F. Inominal Rating: 20 kA.

2.5 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 3R, Type 4X.

2.6 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:
1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 265219 "Emergency and Exit Lighting" for emergency lighting and exit signs.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Submit in collated and bound brochures, with fixture type clearly identified on each cut.

3. Include manufacturer and catalog number.
4. Include data on features, accessories, and finishes.
5. Include physical description and dimensions of luminaires.
6. Include emergency lighting units, including batteries and chargers.
7. Include LED driver, including efficiency.
8. Include lamp life, fixture output (delivered lumens), color temperature (CCT), color rendering (CRI), voltage, and energy efficiency data (luminaire watts).
9. Include photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project. Conform to IES LM-79andIES LM-80.

    a. Testing Agency Certified Data: Photometric data certified by a qualified independent testing agency.

1.5 INFORMATIONAL SUBMITTALS

A. Notarized Affidavits and Test Reports: Obtain from each manufacturer and light diffusing system manufacturer certifying that all light transmitting plastic is in compliance with Michigan State Fire Safety Board Requirements and Memorandums covering plastic materials as interior finishes.

B. Emergency Illumination Verification: Provide point-by-point plot of emergency illumination levels, in footcandles, for all areas of the building with emergency illumination.

1. Illumination levels shall be initial footcandles, at the floor, shown on a 2 foot square grid. Indicate maximum, minimum, and average footcandle levels, and maximum-to-minimum illumination uniformity ratio. Base calculations on 80 percent/50 percent/20 percent ceiling/wall/floor reflectances.
2. Base calculations on actual luminaires and lamp/driver systems installed.
3. Building footprint with luminaire layout, in electronic Auto-CAD format, will be available from the Architect.
4. Provide three (3) copies of all documentation for Architect review and comment. Revise calculations as required, and provide six (6) copies of final documentation.

C. Qualification Data: For testing laboratory providing photometric data for luminaires.

D. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

B. Warranties: Special warranties specified in this section.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Comply with Michigan State Fire Safety Board Requirements and Memorandams.

1.8 COORDINATION

A. Confirm compatibility and interface of ceiling system and other materials with luminaire mounting. Report discrepancies to Architect, and defer ordering until clarified.

B. Supply plaster frames, trim rings and backboxes to other trades.

C. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the manufacturers specified in the Lighting Fixture Legend on Drawings.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598.

E. Recessed Fixtures:

1. Comply with NEMA LE 4.
2. Provide integral thermal protection.

F. Bulb shape complying with ANSI C79.1.

G. Lamp base complying with ANSI C81.61orIEC 60061-1.

H. CRI of minimum 80. CCT of 3500 K.

I. Rated lamp life of minimum 50,000 hours.

J. Lamps dimmable from 100 percent to 1 percent of maximum light output unless otherwise indicated.

K. Internal driver, unless otherwise indicated.

L. Nominal Operating Voltage: As specified in the Lighting Fixture Legend on Drawings.

M. Drivers with Supply Voltage Greater than 150 Volts: Provide Bussman HLR in-line fuse holders and Bussman GLR fuses for each driver.

N. Remote Drivers: Provide enclosure with integral junction box for wire connections, where indicated on Drawings.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Painting: All recessed troffers shall be factory painted after fabrication.

D. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch nominal unless otherwise indicated.
4. Light transmitting plastic in lighting fixtures and light diffusing systems shall conform to Michigan State Fire Safety Board Rules and Memorandums.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all fixtures delivered to jobsite prior to installation to ensure all specification requirements and shop drawings notes and comments have been incorporated by manufacturer. Installation of fixtures signifies Contractor's acceptance and approval of fixtures from manufacturer.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Remote Mounting of Drivers: Distance between the driver and luminaire shall not exceed that recommended by driver manufacturer. Verify, with driver manufacturers, maximum distance between driver and luminaire.

C. Install luminaires per manufacturer's recommendations, level, plumb, and square with ceilings and walls unless otherwise indicated.

D. Support fixtures directly from building structure by rod hangers or metal angle headers supported from framing structure or from appropriately rated ceiling grid system. Do NOT support from metal roof decks.

E. Provide all rod hangers, metal angle headers, anchors, clamps, etc., to support fixtures.

F. Provide supplemental support for fixture installations that put excessive stress on ceiling system.

G. Install lamps in each luminaire.

H. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them.

I. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.
4. In accessible ceilings, install to permit access to outlet or prewired fixture box from below.
5. Connect to boxes with flexible conduit and fixture wire, or MC or AC cable.

K. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls or using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

L. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
3. Ceiling mount with hook mount.

M. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices. Route fixture wiring down one stem.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not run wiring horizontally between rows of fixtures.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

N. Recessed Lighting Fixtures:

1. In accessible ceilings, install to permit access to outlet or prewired fixture box from below.

2. Connect to boxes with flexible conduit and fixture wire, or MC cable.

O. Align lighting fixtures and clean diffusers prior to final acceptance.

P. Adjust aimable lighting fixtures as directed by Architect and to provide required light intensities.

Q. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

R. Drivers:

1. Factory mount drivers unless otherwise indicated.
2. Mount drivers located remote from fixture on steel channels to provide 1 inch air space between driver and mounting surface.

S. Emergency Lighting Units: Connect to same branch circuit serving normal lighting in room or area, ahead of any local switches.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

B. Related Sections include the following:

1. Section 265119 "LED Interior Lighting" for LED interior lighting.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Arrange in order of luminaire designation.
2. Submit in collated and bound brochures, with fixture type clearly identified on each cut.
3. Include manufacturer and catalog number.

4. Include data on features, accessories, and finishes.
5. Include physical description of the unit and dimensions.
6. Battery and charger for light units.
7. Include lamp life, output of luminaire (lumens), color temperature (CCT), color rendering (CRI), voltage, and energy-efficiency data (luminaire watts).
8. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

    a. Testing Agency Certified Data: Photometric data certified by a qualified independent testing agency.

1.5 INFORMATIONAL SUBMITTALS

A. Notarized Affidavits and Test Reports: Obtain from each manufacturer and light diffusing system manufacturer certifying that all light transmitting plastic is in compliance with Michigan State Fire Safety Board Requirements and Memorandums covering plastic materials as interior finishes.

B. Emergency Illumination Verification: Provide point-by-point plot of emergency illumination levels, in footcandles, for all areas of the building with emergency illumination.

1. Illumination levels shall be initial footcandles, at the floor, shown on a 2 foot square grid. Indicate maximum, minimum, and average footcandle levels, and maximum-to-minimum illumination uniformity ratio. Base calculations on 80 percent/50 percent/20 percent ceiling/wall/floor reflectances.
2. Base calculations on actual luminaires and ballast/driver systems installed.
3. Building footprint with luminaire layout, in electronic Auto-CAD format, will be available from the Architect.
4. Provide three (3) copies of all documentation for Architect review and comment. Revise calculations as required, and provide six (6) copies of final documentation.

C. Qualification Data: For testing laboratory providing photometric data for luminaires.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

B. Warranties: Special warranties specified in this section.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.8 COORDINATION

A. Confirm compatibility and interface of ceiling system and other materials with luminaire mounting. Report discrepancies to Architect, and defer ordering until clarified.

B. Supply plaster frames, trim rings and backboxes to other trades.

C. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Power Unit Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining four years.
2. Warranty Period for Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Emergency Lighting and Exit Signs: Subject to compliance with requirements, provide products by one of the manufacturers specified in the Lighting Fixture Legend on Drawings.

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598.

F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.

G. Bulb Shape: Complying with ANSI C79.1.

H. Nominal Operating Voltage: As specified in the Lighting Fixture Legend on Drawings.

2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Glass: Annealed crystal glass unless otherwise indicated.
2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
4. Light transmitting plastic in lighting fixtures and light diffusing systems shall conform to Michigan State Fire Safety Board Rules and Memorandums.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Support Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all fixtures delivered to jobsite prior to installation to ensure all specification requirements and shop drawings notes and comments have been incorporated by manufacturer. Installation of fixtures signifies Contractor's acceptance and approval of fixtures from manufacturer.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

C. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

D. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires per manufacturer's recommendations, level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Support fixtures directly from building structure by rod hangers or metal angle headers supported from framing structure or from appropriately rated ceiling grid system. Do NOT support from metal roof decks.

D. Provide all rod hangers, metal angle headers, anchors, clamps, etc., to support fixtures.

E. Provide supplemental support for fixture installations that put excessive stress on ceiling system.

F. Install lamps in each luminaire.

G. Emergency Lighting Units: Connect to same branch circuit serving normal lighting in room or area, ahead of any local switches.

H. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing emergency lighting and exit signs, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265219

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires with LED lamps and drivers.
2. Luminaire-mounted photoelectric relays.

B. Related Sections include the following:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 260943 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
3. Section 265119 "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

H. NAAMM: National Association of Architectural Metal Manufacturers.

1.3 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Submit in collated and bound brochures, with fixture type clearly identified on each cut.

2. Include manufacturer and catalog number.
3. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
4. Details of attaching luminaires and accessories.
5. Details of installation and construction.
6. Luminaire materials.
7. Photometric data based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each luminaire type, complete with indicated lamps, drivers or , and accessories. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project. Conform to IES LM-79 and IES LM-80.

    a. Testing Agency Certified Data: Photometric data shall be certified by a qualified independent testing agency.

8. Photoelectric relays.
9. LED drivers or ballasts, including energy-efficiency data.
10. Include lamp life, fixture output (delivered lumens), color temperature (CCT), color rendering (CRI), voltage, and energy-efficiency data (luminaire watts).
11. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.
3. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

B. Warranties: Special warranties specified in this section.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

E. Provide luminaires from a single manufacturer for each luminaire type.

F. Each solid-state luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces of luminaires, mounting arms, etc., by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products by one of the manufacturers specified in the Lighting Fixture Legend on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

C. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

H. Exposed Hardware Material: Stainless steel.

I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

J. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint or anodizing applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color support materials.
   1. Color: As selected from manufacturer's standard catalog of colors.

M. LED LAMPS AND DRIVERS

   1. CRI of minimum 80. CCT of 3500K unless noted otherwise.
   2. L70 lamp life of 50,000.
   3. Lamps dimmable from 100 percent to 10 of maximum light output.
   4. Internal driver.
   5. Nominal Operating Voltage: As shown on the Lighting Fixture Legend on Drawings.

6. Lamp Rating: Lamp marked for outdoor use.

N. SOURCE LIMITATIONS

1. Obtain Luminaires from single source from a single manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all fixtures delivered to jobsite prior to installation to ensure all specification requirements and shop drawing notes and comments have been incorporated by manufacturer. Installation of fixtures signifies Contractor's acceptance and approval of fixtures from manufacturer.

3.2 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming at night. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.3 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

END OF SECTION 265600